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Forthcoming Event.

APRIL 18.

Staffordshire Iron and Steel Institute:—Ordinary meeting at Dudley "Notes on a Direct Process for the Manufacture of Iron."

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

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Unification of Effort in Foundry Research and Effort.

Such material progress has been made during the last decade in the study of cast iron that bodies other than those definitely associated with the foundry industry are beginning to interest themselves, but unfortunately often they have not the common decency to take foundrymen into their confidence. For instance, a railway company has recently put forward a specification for axle boxes, which many prominent foundrymen consider to be totally unsuitable. Again, we recently inspected a draft report on foundry education drawn up without reference to any of the national foundry organisations. It, too, was merely a collection of oft-repeated and widely-circulated elementary observations and platitudes, with no new matter or workable concrete suggestions. Now we hear of a large national research organisation that is asking for subscriptions to carry out a research on the higher carbon field of the iron-carbon system, or, in other words, white cast iron. They will no doubt continue with a study of ternery systems taking in silicon as the first one; this means grey cast iron. Obviously, foundrymen will welcome such a study, but if such work, as is usually the case, neglects the influence of mass, then they are entitled to ask whether the utility could not be increased and the cost lowered by working such a research in co-operation with the British Cast Iron Research Association. This body, being in direct touch with the industry, could have the "influence of mass" aspect of the case given its rightful place. *Prima facie*, a research on the alloys representing pure cast iron is of more interest for foundrymen than any other industry, and if national research organisations desire to be of maximum value to industry, then they must be thoroughly *au courant* with the best and most recent thought in that industry. Surely close co-operation from the commencement is an essential. It is axiomatic that if a person shouts sufficiently long and loud he will be heard. It is equally applicable to an industry, and foundrymen must be "noisy" in the future. They must create live committees to study and report upon their vital problems. The committee appointed by the Institute of British Foundrymen, under the chairmanship of Mr. J. Shaw, to consider the test-bar question has done well, but others, not necessarily associated with this organisation, have failed to meet their responsibilities. So long as these conditions are permitted to exist outside bodies will continue to impose foundry specifications, carry out foundry research, and draw up schemes for foundry apprentices. The cause of this duplication of effort—because it is a *duplication* since foundrymen *are* moving in these matters—is that the voice of the foundrymen is insufficiently loud. Unification can be established by the arranging of joint meetings with allied *national* research, technical and industrial organisations to consider vital yet mutual questions. We feel sure they would be welcomed. Sooner or later many industries for which foundries cater will be considering the standardisation of parts to cheapen production. Foundrymen must make efforts to co-operate at the commencement of each movement, and not wait until the question is *un fait accompli*, and then call a meeting to consider as to which is the best way to meet the new conditions imposed. The French Foundrymen's Association are devoting a special session to the standardisation of patterns at their next conference, and are thus leading French industry. It thus gives to British foundrymen a pointer which can usefully be followed.

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The Welsh Tinplate Selling Agency.

Capital of £700,000.

Particulars have become available this week of the registration of the South Wales Tinplate Corporation, Limited, the selling agency which has been formed to centralise the disposal of Welsh tinplates throughout the world. The scheme is not quite so comprehensive as the arrangement arrived at some time ago to maintain minimum prices in the tinplate and tinplate-bar trades, but nevertheless approximately 60 per cent. of the tinplate trade is embraced in the present enterprise. The combine, of course, includes the firm of Richard Thomas & Company, Limited, which, with subsidiaries and associated concerns, are responsible for at least 40 per cent. of the output at the present time.

Advantages of the Agency.

The claims of the tinplate makers associated with the new Corporation have frequently been referred to in these columns, and it is obvious that they must always run counter to the interests of merchants, factors, and others associated with the selling side of the industry. Undoubtedly the principal claim is that one of the chief advantages of the central selling agency will be that it is solely interested in Welsh plates. It must certainly concentrate its efforts in a manner that the merchants and factors, who may, and probably do, serve several interests, cannot do. After allowing for what the merchant has done in the past towards developing and nursing the foreign demand for Welsh tinplates, there is still a wide field for future activities, and it is this potential demand which the new Corporation, with every possible resource which alone can be at the command of a wealthy concern, will be in a very favourable position to develop.

Antagonistic Merchant Interests.

From the very inception of the new scheme many months ago the merchant side of the business has viewed it with some consternation and undisguised antagonism. Naturally they fear that the central selling agency will absorb much of their business. It is an open secret that the merchant trade have been unable to live on the 1 per cent. discount allowed to them latterly, and it has only been by financing customers and by other similar activities that the tinplate merchants have been able to pay their way at all.

It is recognised, of course, that the Corporation is merely a product of the trend of modern business ideas, but it is also recognised that by a process of price-cutting it might easily eliminate the remainder of the merchants and factors. It should not be forgotten, however, that the adoption of such a policy, which has already been successfully carried out by the milk and other combines, might in this instance defeat its objects. It might, for instance, be responsible for a combination of the remaining 40 per cent. of the makers and a goodly proportion of the merchant interests, and might incidentally lead to the breaking up of the agreement between the tinplate and tinplate-bar people, which would certainly not be in the best interests of the trade.

However, to return to the merchants' grievances, they are getting some consolation from the argument that the agency will prove to be rather an expensive organisation, and is likely to lead to heavy overhead expenditure. In addition, the financing, not to mention the risks, of the business will fall upon the concern directly associated with the works, instead of through a variety of sources. They also argue that it must be perfectly clear to the combination that it can hardly expect the support of merchants and exporters. The latter will undoubtedly turn to those works which are outside the scheme, and thereafter to American manufacturers, and herein, in our opinion, lie the germs of a "price war" with all its ramifications. It may be said for the merchant that he has acquired very special knowledge of foreign trading conditions, particularly in the East, and it will certainly not be a cheap matter for the Corporation to carry on this business in the early stages of its career, even if it is successful ultimately. At any rate, the Americans have had painful experience of this, in spite of their aggressive sales campaigns from time to time. There is, on the other hand, of course, nothing to prevent the new combination selling to merchants who have special facilities for handling special markets; indeed, Richard Thomas & Company always did this, although they maintained their own merchant houses. The main advantage of combination is the influence which a large concern with ample capital can bring to bear in the development of new markets and the retention of old ones when it is necessary at times to take orders temporarily at a loss.

The Associated Concerns.

The South Wales Tinplate Corporation, Limited, was registered as a private company on March 31, with a nominal capital of £700,000 in £10 shares. The objects are: To adopt an agreement between W. J. Firth (as trustee for the company) and Richard Thomas & Company, Limited, the Grovesend Steel & Tinplate Company, Limited, the St. David's Tinplate Company, Limited, the Kidwelly Tinplate Company, Limited, the Villiers Tinplate Company, Limited, W. Gilbertson & Company, Limited, the Ashburnham Tinplate Company, Limited, the Baglan Bay Tinplate Company, Limited, the Resolven Tinplate Company (1919), Limited, the Ferry Tinplate Company, Limited, the Aberavon Tinplate and Stamping Company, Limited, and the Ffrwdwyllt Tinplate Company, Limited, and to carry on business as general agents and merchants, tinplate manufacturers, etc. Power is taken to join and contribute towards the funds of any masters' or employers' association having among its objects the entering into of selling and buying arrangements, the conducting and settlement of disputes with employés, resistance to combinations of workmen, mutual assistance in labour troubles, the arrangement of rates of wages, the promotion of or opposition to legislative reform, or co-operation with other associations, provided that the objects of the company shall not extend to any of the purposes mentioned in Section 16 of the Trade Union Act Amendment Act, 1876 (39 and 40 Vict. cap 22).

Allotment of Shares.

Shares Nos. 3 to 55,002 are to be allotted as follows, and the companies named are, while retaining such shares, to be entitled to appoint directors as indicated:—

Shares numbered.	To be allotted to
3 to 27,752	*Richard Thomas & Company.
27,753 ,, 41,502	*Grovesend Company.
41,503 ,, 44,252	†St. David's Company.
44,253 ,, 46,002	*Kidwelly Company.
46,003 ,, 47,502	*Villiers Company.
47,503 ,, 49,002	*W. Gilbertson & Company.
49,003 ,, 50,002	*Ashburham Company.
50,003 ,, 51,002	*Baglan Bay Company.
51,003 ,, 52,002	‡ Resolven Company.
52,003 ,, 53,002	‡ Ferry Company.
53,003 ,, 54,002	‡ Aberavon Company.
54,003 ,, 55,002	‡ Ffrwdwyllt Company.

* One director. † Two directors.
‡ One director jointly.

The First Directors.

The first directors are: H. C. Bond (nominated by Richard Thomas & Company), W. J. Firth (nominated by Grovesend Company), W. I. Williams and H. W. Morgan (by St. David's Company), J. Thomas (by Kidwelly Company), C. D. Godfrey (by Villiers Company), F. W. Gilbertson (by W. Gilbertson & Co.), A. A. Lewis (by Ashburnham Company), M. Morris (by Baglan Bay Company), J. M. Bevan (by Resolven and Ferry Companies), and H. D. Rees (by Aberavon and Ffrwdwyllt Companies).

Any other member of the company holding ordinary shares numbered 55,003 upwards shall have the like right of appointing one director, provided that he holds ordinary shares of a nominal value of at least £25,000. The board may from time to time appoint three additional directors, to hold office for one year, and to be eligible for re-election. Such additional directors shall be entitled to attend board meetings and to have full information and to exercise all the powers and rights of directors, except that they may not vote at a meeting of directors. Each director is to be allowed £250 per annum for expenses. The board may vote additional remuneration for special services, residence abroad, etc. A director need not hold any qualification shares. No notice of situation of registered office was filed at the time of incorporation.

In the first three months of this year forty-three boilers of various types have been fitted with the forced draught furnaces and/or mechanical stokers of Meldrums, Limited, Engineering Works, Timperley, near Manchester. Other orders include fifteen refuse destructors, some for incineration only and others with water heaters or boilers for heat utilisation. Thirteen sets of portable steam disinfectors have been supplied to the War Office, Crown Agents for the Colonies, etc., together with chemical plant in "Meldrum" acid-resisting and other metals. Amongst the latter may be noted nine centrifugal pumps, eighty cocks and valves, thirty steam jet appliances (such as compressors, elevators, ejectors, agitators, silent water heaters, etc.); also jacketed pans, tanks, pipes, etc., in "Meldrum" acid-resisting metal. A gas washing plant has also been supplied to the March Gas Company.

Motor Cycle Cylinders.*

By J. Leonard (Past-President of the Belgian Foundrymen's Association).

Since everyone is familiar with the usual form of motor-cycle cylinder a general description of the casting is unnecessary. Attention will be directed to the conditions which are to be met from the founder's point of view. Apart from the general appearance of the cylinder the most striking features of the exterior aspect are the skin finish of

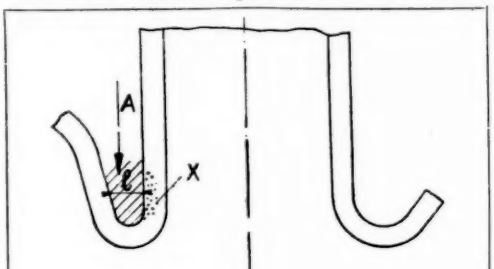

FIG. 1.

the casting, the freedom from defects, the regularity of the fins and the accuracy of alignment of the several parts of the mould; all these furnish evidence that a motor-cycle cylinder is not only well made but is also of good appearance.

The same remark applies to the interior; the bore must be beyond reproach, at any rate over the piston-swept area. Some makers allow more or less tolerance outside this area, but others insist on practical perfection throughout. This, of course, is not only a question of appearance, for the working of the motor may be seriously affected by the presence of a blow-hole situated, say, near the edge of the compression space. Valve seats, too, must be perfectly sound and free from defects. Only the slightest defects can be permitted on other surfaces of the casting, joints must be sound and tight, and valve caps must be free from leakage. In short, the large proportion of machined surfaces and their extreme importance make the motor-cycle cylinder a difficult piece to produce successfully; blow-holes, sand inclusions and all other defects must be eliminated as far as possible.

Tolerances.

With regard to the question of tolerances it may be remarked that machinists themselves allow them. Some parts may be required to be of the greatest possible accuracy; in others a tolerance of 0.004 in. may be permitted, or, perhaps, only 0.001 in., whilst it may even be permissible to

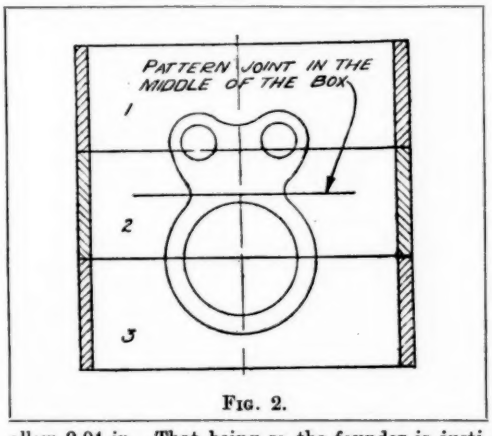

FIG. 2.

allow 0.04 in. That being so the founder is justified in demanding a similar latitude. It is clear that the cylinder must be impervious in the bore, in the admission and the compression spaces, and in the lower part of the bore. But absolute tightness is not necessary in the exhaust chamber, since this is equivalent to the atmosphere. This last remark has some significance because, generally speaking, the hydraulic test is applied to the cylinder as a whole, and the inspector may not admit that any particular portion should be exempt from perfect soundness.

Hardness.

The hardness of the iron is important, and must be of a degree that will permit the necessary polishing of the bore, and offer the greatest resistance to wear. On this question of hardness different views are held; some designers demand hardnesses that others ignore. In Belgium cylinders are made with No. 3 iron, giving Brinell hardnesses of 170 to 180. These cylinders satisfy the Belgian manufacturers, and that they also satisfy many English makers is proved by the enormous numbers ordered by them; yet there are English founders who cast cylinders with irons giving Brinell figures of 210 to 220. It appears that the increasingly severe duties demanded of motor-cycle engines will necessitate the use of harder irons by the Belgian makers. This matter, however, merits investigation because the engine maker may complain that the cylinders wear out too fast without seeking for

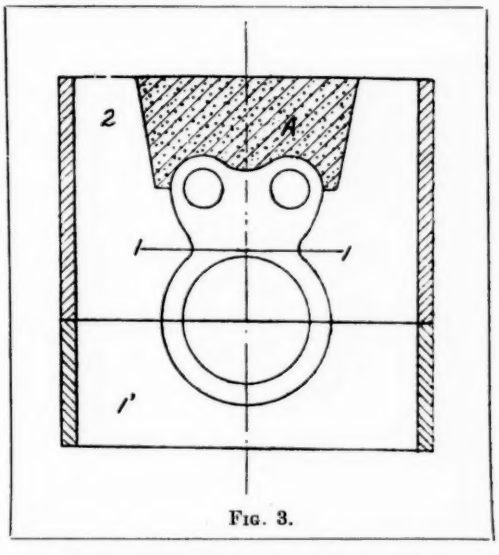

FIG. 3.

the other reasons that may lead to this result. The founder also being in ignorance does not know how to correct the defect. Certain manufacturers have come to the conclusion that hardness of the iron is not the most important factor, and that the most effective degree will be found between 190-200. This figure represents the best resistance to wear, consistent with machinability, and other destructive agencies must be dealt with outside the foundry.

To emphasise the necessity for the user to be quite clear as to his requirements, it may be mentioned that a user of bronze castings demanded an alloy containing 14 per cent. of tin, which was to machine easily; the conditions were impossible to satisfy simultaneously. The manufacturers of cylinder castings are faced with the equally contradictory demands of the user, who requires a metal highly resistant to wear, and the machinist who specifies that the material must "work" easily.

Composition Recommended.

In view of these demands it is essential that a closer study of the matter should be made, before, during and after the making of the casting; so that the data available from both sides may be used to put the matter on a scientific basis. Mechanical strength is hardly taken into consideration. In some countries a semi-steel is advised, but there appears to be no sound reason for the choice except for the more complete freedom from spongi-

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* Translated from *Revue de Fonderie.*

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ness—a fact which is attributable to matters quite apart from the metal, as will be shown later. Metal of the following chemical composition has given entire satisfa on from the point of soundness, and also meets the requirements of hardness:—Brinell No. 190-200; silicon, 2.50 to 3.00; phosphorus, 0.8 to 1.00; manganese, 0.8 to 1.00; sulphur, 0.08 to 0.12; and total carbon, 3.2 to 3.3 per cent. Finally, motor-cycle cylinders are light, the thickness being limited to a bare $\frac{3}{16}$ in. The fins are often very thin and of large diameter, and are difficult to "run." Some cylinders are furnished with fins more than $1\frac{1}{2}$ in. deep, varying in thickness from little more than $\frac{1}{8}$ in. at the base to less than $\frac{1}{16}$ in. at the outer edge. These fins are of great importance, they must be sharp and clean, as, on their appearance, the "finish" of the cylinder so largely depends.

Designing Desiderata.

In the design of these cylinders the designer must take into account the difficulties of the moulder, his technical and mechanical difficulties.

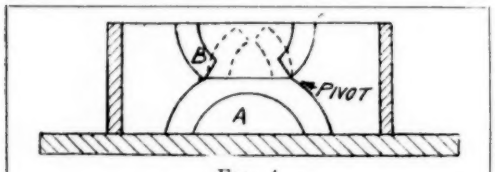

Fig. 4.

By intelligent co-operation between designer and moulder it has been found possible to modify the usual pattern to permit, often, machine moulding and nearly always mechanical stripping of the pattern. Fig. 1 illustrates an actual example of correction by the foundry. It was found that the wedge of sand in the narrow annular space "A" caused sponginess at "X." By slightly increasing the distance "1," the trouble disappeared, and sound castings resulted. This was demonstrated by trial, and the drawing-office altered the design. Another difficulty, and consequently another annoyance, is suffered by the moulder from the demands that the casting shall be *easy* to machine. The operation of boring demands accuracy; a cored hole out of truth will cause the drill to be sprung, or, at any rate, it will not be rigidly guided. The requirements of the machinist are reasonable, but the foundryman sees the thin parts of his casting adjacent to the more massive portions, and knows how fatal such a situation is to the accuracy demanded, for it is the cause of pulls. The founder must be fully awake to this view; some cases are easily solved, a harder iron or one less phosphoric; a little lighter ramming, or a better vented core may lead to a solution or an easing of the difficulty. Some-

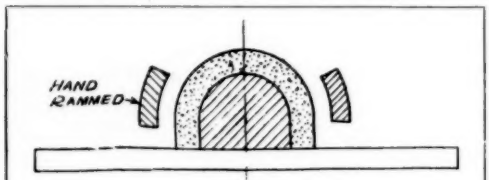

Fig. 5.

times the difficulty will be so formidable that the founder is helpless, in which case it remains for him to ask the other departments to take up the problem.

Making the Patterns.

Wood patterns are only serviceable for making experimental models. No matter how much care has been expended on them the very thin radiating fins will twist and become distorted, making the pattern difficult to draw; these delicate fins break and their repair by hand is a very difficult matter and is always unsatisfactory.

Metal Patterns.

Thus metal patterns are necessary even for hand moulding. Brass or bronze patterns are specially recommended. For machine moulding, white metal patterns are good enough, provided the fins are not very deep. For mechanical stripping a stripping plate is necessary. This device can be of iron, with a lining of white metal, which can be cast in place between the stripping plate and the pattern. The stripping plate may be of any other metal such as sheet brass $\frac{1}{16}$ in. thick, cut out to correspond with the profile of the pattern. For this method of stripping the fins are part and parcel of the pattern.

Some foundries first strip the lower fins, in which case they pass along the body of the pattern, which thus acts as the stripping plate. Cylinders of the simplest design can be moulded in two boxes; others, as illustrated in Fig. 2, require three boxes. These are particularly difficult to deal with successfully, because they require three partings. The middle part includes two portions of the pattern which must be withdrawn in

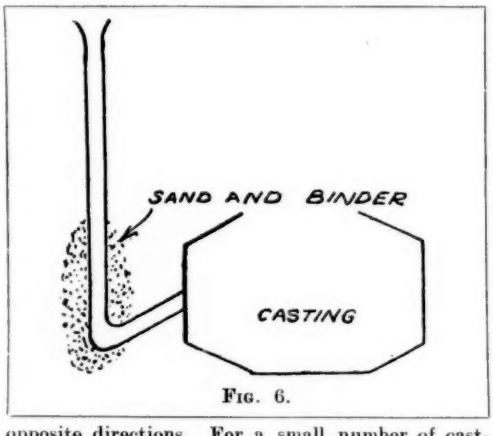

Fig. 6.

opposite directions. For a small number of castings an attempt has been made to eliminate the third flask by substituting a core fitting into the space left by a print on the pattern, as shown at "A," Fig. 3. This method seems to merit further attention; it eliminates the third box with its troublesome parting, and it appears that the cope, Fig. 3, can be made up more quickly than middle part, shown in Fig. 2. The core "A," Fig. 3, is also made more quickly than the cope, Fig. 2. A combination, both original and interesting, has been tried, as shown in Fig. 4. The box part, II, was placed on a pattern plate P, when lifted, the part A of the pattern was left behind on the plate in the normal manner, but the fins of the portion B were pivoted on the fixed portion A, and by a

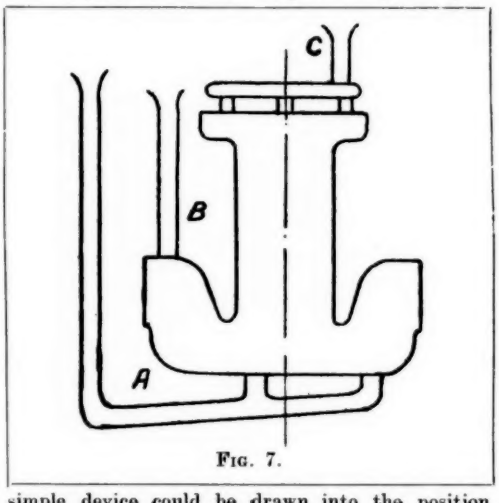

Fig. 7.

simple device could be drawn into the position shown dotted, Fig. 4, having left their impression in the mould. The portion "B," of the pattern could then be withdrawn, being guided by the corresponding fins.

In some designs, the fins of the valve chamber run parallel to the joint, in which case the bottom is made by a corresponding core. This method does not appear to offer any advantages in either making or assembling; but it does present difficulties to the foundryman, which in most cases should be eliminated.

Moulding.

It is not so many years since all moulding was done entirely by hand, and with the ordinary pattern. But this method is gradually becoming superseded. The motor cycle industry has developed so enormously that hand moulding has become inadequate to deal with the demands. Moulding machines, or, at any rate, stripping machines, have become general. Moreover, hand moulders who specialised in the making of cylinders with radiating fins, were confined to certain regions; a notable example was Huy, from whence came cast cylinders that were the envy of English manufacturers. In none of the great ironfounding districts of Liege, Verniers, or Charleroi, was there anything to compare with the work from Huy, where, alone, the craftsmen could be found.

It was not so much a question of technique of

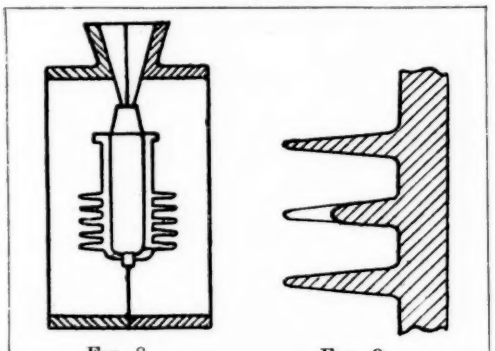

Fig. 8. Fig. 9.

casting or moulding that was the special difficulty, but it was the intense concentration and attention to detail on the part of the workmen, the careful placing and ramming of each fin, and the meticulous care devoted to every step of the operation which one would wish to see on the part of every moulder, but, which, of course, is not always necessary. At the Liege Exhibition of 1921 cylinder castings from this district attracted universal attention by their wonderful workmanship.

Ramming.

Mechanical methods of stripping are largely employed, for they not only facilitate manufacture, but also permit the rapid training of employees for repetition work. In England there are factories which, by the adoption of machine moulding, are able to turn out cylinders requiring three partings yet employing only unskilled labour. In this case, the question of ramming presents the only real difficulty, and it is by no means negligible. There are several points to be noted: the arrangement of the radiating fins as a whole; the adaptation of special ramming to special features, such as fins of exceptional depth, in which ramming may be effected by throwing the sand in handfuls against the pattern, or again by gentle pressing by hand or rammer; the placing in position of all

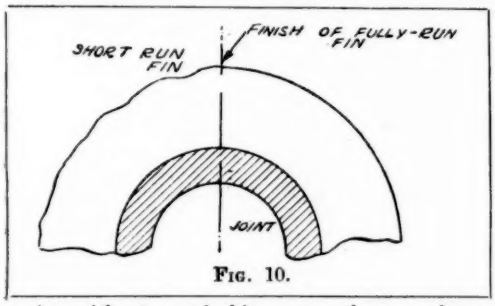

Fig. 10.

sprigs without overlooking any; these, perhaps, are the principal difficulties.

The machines used can be simple stripping machines, with a stripping plate when the fins radiate across the body. Adaptable machines, which strip the fins through a plate and then raise the box from the pattern, are specially recommended. Careful consideration should be given to the selection of the machine, since it frequently happens that a certain design may be handled by a moulding machine of simpler—and consequently less expensive—type than might appear possible at the first glance.

Mechanical ramming is not, so far, extensively employed, in spite of the beautifully finished work and large output that it renders possible. Hand-ramming, no matter how it is done, is necessarily irregular.

The number of thin edges and sharp corners generally found in the design are all points of weakness in the mould. Long experience suggests that in many cases, though not in all, a well rammed mould and without sprigs, is sufficiently robust to withstand the shock of the entering metal. Pressure ramming-machines have been successfully employed in the production of the

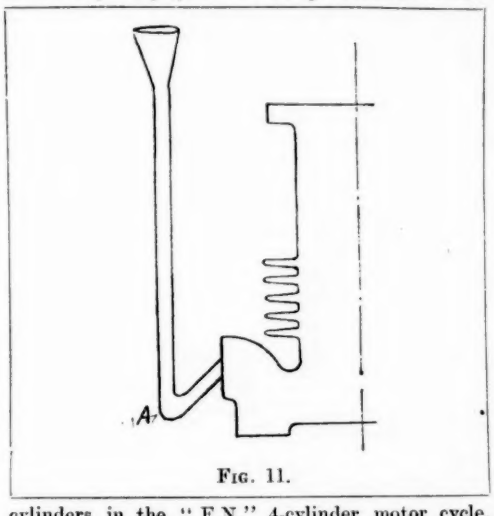

Fig. 11.

cylinders in the "F.N." 4-cylinder motor cycle. This engine has deep radiating fins, 1½-in. in places, yet the whole of the ramming—with the exception of the rather pronounced corner between valve chamber and cylinder body—was done mechanically. The extra precaution was taken of pressing by hand at the points shown in Fig. 5.

Two men, experienced in the production of this casting, turned out 80 moulds in 8 hours; this output included the complete cycle of operations, ending in returning the renovated sand to the moulding machines. Twin cylinder engines of the "Z.V." type were also dealt with successfully: this more complicated type presented a great many difficulties, though little more than when rammed by hand, which suggested the advisability of casting them green.

Machine Moulding.

Machine moulding is capable of more general application; even for cylinders requiring three-part boxes. The cope and drag are certainly feasible, though the middle part does not appear to lend itself to similar treatment.

Jar-ramming machines are not suitable; even in the opinion of those who supply them, they have

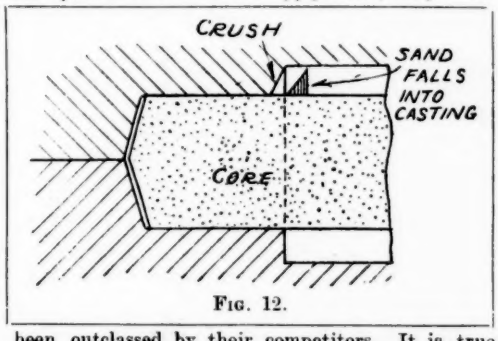

Fig. 12.

been outclassed by their competitors. It is true that in certain cases they have succeeded where others have failed. An instance was furnished when it became necessary to supply some combustion chambers separated by deep fins. The number required was too small to allow the setting up of complicated tools. There was at the time a shortage of moulders sufficiently skilled to undertake the work. Hand moulding was tried, but lack of skill in touching up the fins in the mould led to almost 100 per cent. of wasters. Finally jar-ramming

machines were tried: with the pattern upwards, stripping was an easy matter. By using a white sand with a not-too-strong binder, the difficulty of the fins was surmounted and a robust mould was obtained. The finished casting, though not perfect, fulfilled its purpose. A touch with a file between the fins resulted in a satisfactory finish. It must be admitted that on occasions the ramming was insufficient, and the mould was left porous in places, resulting in scabbiness. However, the desired result was obtained, and castings were produced at a profitable price. White sand is very easy to consolidate, and there is no fear of overdoing it; which is more than can be said of ordinary sand.

Green Dry Sand Moulding.

The success obtained with green-sand castings in bronze, led to the attempt to apply it to cylinders

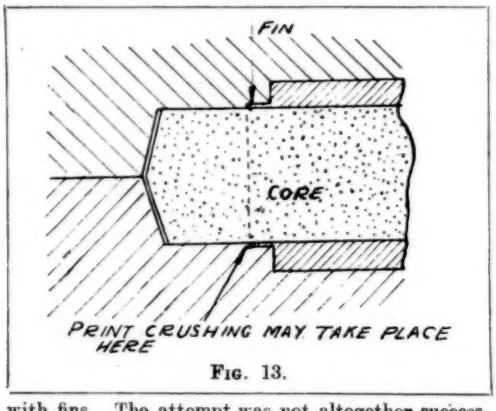

Fig. 13.

with fins. The attempt was not altogether successful with groups of four cylinders *en bloc*. But machine moulding made it possible; hand moulding could not pretend to obtain equal results in view of the subsequent repairs to the mould. Success encouraged the experiments, and led to the belief that a thorough and scientific study of the subject would lead to successful castings of important parts from green-sand moulds.

Runners.

The principal difficulty, of course, with green moulds is to make the runners sufficiently strong to withstand the first shock of the entering metal; the detached sand is carried into other parts of the mould and results in inclusions of dirt. Drying the mould solves this problem easily and completely. In Fig. 6 the runner is shown in sand mixed with a binder, which hardens under the heat, and so becomes able to withstand the flowing

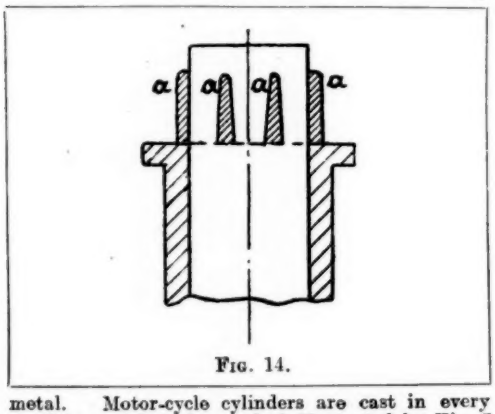

Fig. 14.

metal. Motor-cycle cylinders are cast in every possible way, but the method illustrated by Fig. 7 has long been preferred by the author. In England some very successful makers run the casting at the valve stem guides, that is about mid-way in the length. Cylinders for the Deasy rotary engine were cast by running at "C," Fig. 7, this being the bottom flange when the cylinder is mounted. A method, worthy of greater attention, is shown, also in Fig. 7, at B, and is one that has given excellent results; the metal is run at six, eight or ten points parallel with the fins. The valve seats are far away from the incoming metal, and are found to be cleaner than when the metal is run, as at "A," because the grains of sand, etc., tend to collect in the neighbourhood of the entering metal. True, the same danger exists in the bore, but since the gits are very fine they act as filters to some extent, and also the metal enters via a hard core, which resists erosion by the incoming stream.

The inconsistency of all these methods of pouring suggests that no scientific study of the subject has yet been made, and that far too much reliance is still placed on rule-of-thumb methods. More thought is required in the application of the principles involved.

Sand Considerations.

The sand required for this class of work should be of fine and regular grain, porous, not too strong and thoroughly prepared. These generalities are vague, and would gain much in value by being reduced to figures, but, so far, it is impossible to do so from the available data. In Belgium there is a sand pit at Vinalmont which furnishes an excellent moulding sand, though it is rather weak and must be mixed with a strong sand, previously

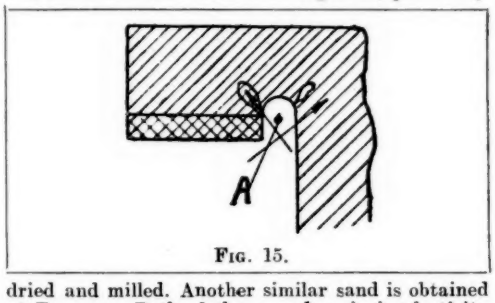

Fig. 15.

dried and milled. Another similar sand is obtained at Tongres. Both of these sands gain in plasticity and strength if left standing for a time after screening. The property of cohesion—so important in the moulding of radiating fins—improves to a measurable extent after standing a while; sand which, if used directly it comes from the mill refuses to strip clearly, will do so perfectly if used the next day. This is a fact that has been proved by experience.

Boxes.

The flasks are poured in the position shown in Fig. 8; they are clamped together in groups of four to nine. It is advisable to fit each flask with a small basin, as shown, thus allowing quick pouring without hesitation.

Short-run Fins.

A number of difficulties were encountered in practice, and a few notes will be added dealing with the manner in which they were dealt with. One trouble—the incomplete running of the radiating fins—developed quite suddenly without any apparent reason. By increasing the speed of pouring the difficulty was overcome, and the proportion of wasters was reduced from about 80 per cent. to

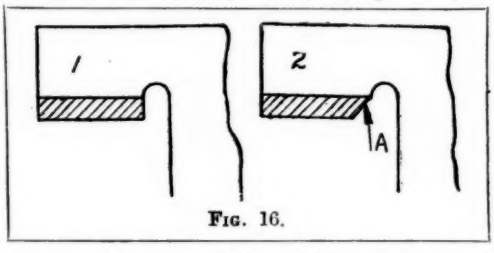

Fig. 16.

the normal figure. Quick pouring is an essential factor which must be recognised by all manufacturers; it was the necessity for this that led to the adoption of the basin mentioned above.

Speed of pouring is not the only factor. A firm turning out 150 cylinders per day and possessing a highly experienced staff found themselves compelled to call in as outside consultant. The trouble was that shown in Fig. 9. Between two perfectly good fins would appear one that had been starved and had only partly run. A review of all the factors was made, cold iron, irregular composition, too high sulphur content, bad sand, insufficient drying, mould too hard, etc., etc. Another symptom was the sudden short running of a fin which for a portion of the diameter was perfect, as indicated in Fig. 10. An examination of the wasters suggested that the cause of the defect was local and faulty drying was indicated, yet it appeared to be sufficient. The fault was traced to

the moulder who, without instructions and for no apparent reason, was using water when touching up the mould, and then dried off more or less completely with a blow lamp. When repairs to the mould were necessary oil should have been used; this is easy to dry off, and even if drying is incomplete there is little to fear. By correcting this simple error the trouble disappeared.

Loose sand may occur at the point " A " (Fig. 11), and be carried forward by the first rush of metal subsequently appearing as a dirt inclusion in the casting. In a dry mould the remedy is simple, a stronger sand or the admixture of a little binder at the point " A " will suffice. For a green sand mould the ramming must be harder at this point; it may be necessary to hand ram a little before machine ramming is begun. Crushing when inserting cores may be avoided by leaving a small annular clearance, as shown in Fig. 13; the thin fin thus formed is easily broken off, and the crushing indicated in Fig. 12 is avoided.

Sponginess.

Sponginess occurring in the face adjoining the crank case—the upper face in the mould—may be eliminated by furnishing a false head, which also assists machining by providing something to be gripped. This extra allowance need not exceed 3-16 in., especially if the additional precaution, shown in Fig. 14, is taken. A crown of little prongs is provided around the cylindrical core; these projections simply act as small risers.

Scabs and dirt in the bore sometimes arise from the design. A motor-cycle cylinder is an awkward casting, and two incoming streams of metal are often only divided by a thin partition of sand, which may be unable to withstand the double attack.

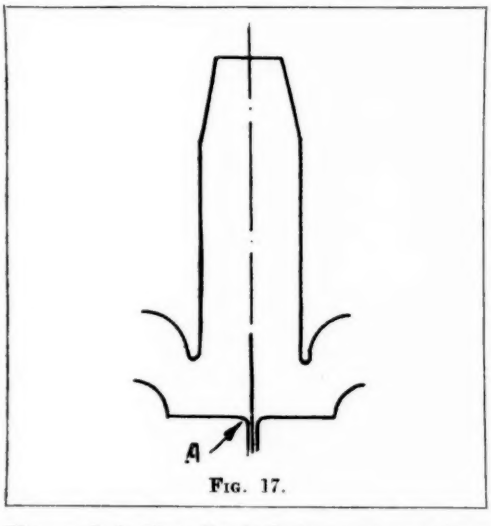

Fig. 17.

The result is that dirt inclusions and sponginess are found when machining the bore. There are two methods for correcting this trouble; one is to eliminate the first cause by increasing the permeability of the sand in the danger zone. The second method is to provide metal that will quickly solidify; less silicon, more manganese, less phosphorous, and less carbon, by intensifying this method, what may be called a semi-steel is approached.

Undercutting, for machining purposes or for the sake of appearance, as shown at " A," Fig. 15, may lead to the development of sponginess and even to cracks penetrating to the exterior; these may not show until the casting has been partly machined. The remedies are: (*a*) to increase the permeability of the sand; (*b*) to avoid as far as possible the sharpness of the corner I (Fig. 16), by tapering away, as shown at II A (Fig. 16). It is a fact that this sponginess occurs very often on the runner side of the mould, but the explanation which attributed this to the " scum " of iron was wrong. An experiment which was said to prove this hypothesis had a much simpler explanation, for the means adopted provided a much freer escape of the gases.

There is a danger of sponginess developing around the hole at A, Fig. 17, when it is so small that an iron rod must be used as a core. In such cases the following dressing applied cold to the rod and dried with the core has been found useful: Alcohol 1¼ gals.; shellac, 3¼ to 5½ lbs., and mineral blacking, 7 ozs. First dissolve the shellac in the alcohol and then add the mineral blacking. This dressing not only eliminates the danger of sponginess, but also prevents the sticking of the metal to the core-rod.

In the case of special experimental motors with separate combustion heads, the cylinder body can easily be made by casting a block of aluminium around an iron liner and then turning the fins out of the solid. The danger of the shrinkage stresses rapturing the thin aluminium shell may be avoided by re-heating the whole to 400 or 500 deg. C. In spite of all precautions wasters are unavoidable, the proportion may be down to 2 or 3 per cent. in easy castings in which appearance is not important, or in which " filling " or welding can be employed to fake them. But a proportion of 10 per cent. must be considered normal for motor-cycle cylinders, and it is not fair to expect a foundry manager consistently to better this figure.

Company News.

Leeds Forge Company, Limited.—Loss for year, £95,189.

Weardale Lead Company, Limited.—Interim dividend, 5 per cent., less tax.

Hadfields, Limited.—Dividend on ordinary shares, 4 per cent., less tax, for year.

Vulcan Foundry, Limited.—Dividend on ordinary shares deferred until end of year.

English Electric Company, Limited. — Dividend, 5 per cent., less tax, on ordinary shares.

Brush Electrical Engineering Company, Limited.—Dividend, 10 per cent., less tax, for year.

John C. Parkes & Sons, Limited.—Net profit, £4,490; available, £7,941; final dividend, 3 per cent., making 7 per cent.; carried forward, £3,010.

London Electric Wire Company & Smiths, Limited.—Profit, £77,470; brought forward, £30,671; reserve, £30,000; final dividend on ordinary shares, 6¼ per cent., making 7½ per cent., less tax, for year; carry forward, £29,836.

Barrow Hematite Steel Company, Limited.—The sixtieth annual meeting was held in London on April 2. Mr. G. Mure Ritchie, who presided, said that in the early months of the year there was a distinct improvement, both in the volume and prices of iron and steel, consequent on the French action in the Ruhr, but the absence of a coherent national trade policy had a very detrimental effect on their industry. A reasonable export duty on coke and coking coal would have enabled us to obtain industrial fuel at a more reasonable price. The suggestion that the French policy in the Ruhr had been the cause of increasing British unemployment, and that it was hindering the recovery of British trade, the chairman described as a blatant falsehood. This suggestion had undermined confidence in this country, though it had not deflected the French policy, and the result was that by the beginning of the summer of last year, and until the autumn, the iron and steel trades had become as acutely depressed as ever before. The natural conditions of the South Yorkshire coalfield were amongst the most favourable in Britain. Large outputs and good wages were easily realisable for industry and regular attendance. But, unfortunately, the indolence and absenteeism of a large proportion of coal-getters was almost incredible to those not acquainted with the facts. During 1923, 37,603 shifts were lost through wilful negligence. The actual shifts worked were 205,138, the wages paid being £147,251, or 14s. 4d. per shift of seven hours, which meant only about 5½ hours' work. The average output per coal-getter for the year was 2.57 tons per shift, and, assuming that for the shifts lost the same amount per man would have been obtained, the additional output accruing would have amounted to 96,640 tons, which would have given a total of 625,447 tons for the year. The wages lost to coal-getters through absenteeism during the year amounted to £26,948, or an average of £28 per coal-getter per annum. Had the shifts lost through negligence been worked, the cost of raising the whole possible output would have been reduced considerably per ton. Speaking generally, there was no justification for the demands now being made by the Miners' Federation. The coal industry was to a large extent one of the sheltered industries, and the high price of coal, combined with the high wages paid to railwaymen, in both cases for shorter hours and less work than need be, constituted one of the serious factors which had kept British industry generally in a depressed condition. A suggestion that the meetings be held at Sheffield, Manchester or Barrow was defeated, and the report adopted.

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Semi-Steel.

By Professor A. Campion, F.I.C.

A meeting of the Birmingham Branch of the Institute of British Foundrymen was held at the Chamber of Commerce, on March 13, Mr. J. B. Johnson (Branch-President) in the chair.

The President extended a hearty welcome to the Midlands to Professor A. Campion, of Glasgow, whose subject of "Semi-Steel," he said, was of great interest to foundrymen.

Professor Campion said that for a long time founders, engineers and general users of cast iron had been conscious of its limitations as compared with its near relation—steel—the principal drawback to cast iron being, of course, its want of ductility. Steel was only a purified form of cast iron, and many people had tried to confer some of the properties of the purified material upon what might be called the raw material. Many attempts had been made to improve the ductility and other properties of cast iron, mainly by the use of physic or dope, or the addition of other ingredients, but the only proposal which could be seriously considered was the melting together of cast iron and steel or wrought iron scrap. The idea, however, was by no means new, and did not originate in America as some people would have them believe, but in this country, in 1846, by J. M. Stirling, who took out a number of patents for a method of preparing what he described as "toughened cast iron," for use for certain purposes where a metal possessing greater strength or tenacity than ordinary cast iron is required and where it is an object to vary the hardness. Price and Nicholson patented a process in 1855, using a mixture of refinery iron with other irons, the object being to lower the silicon and leave the carbon more or less unaltered, a process which at the best could have but very limited use, and the introduction of the Bessemer process caused its abandonment. The original idea of Stirling was, no doubt, to try and mix cast iron and wrought iron in order to obtain a mixture which would possess more or less the properties of both metals, and it was probably the same idea which gave rise to the very much debated name of semi-steel. Unfortunately, a mixture of the two materials exhibited none of the special properties usually attributed to steel. It was unforgeable and, in the ordinary sense, unweldable, and wanting in ductility.

The Definition of Semi-Steel.

What then was semi-steel? If it was a mixture of the two and had none of the properties of steel, what then was it? The name was unfortunate. It was not the best or the most desirable name, but he was afraid it had become too much in common use to alter it. At any rate, foundrymen knew pretty well what was meant by it, and so, he thought, did the majority of users. At the same time it seemed desirable that there should be some recognised definition of what they meant by semi-steel, why it was supposed to be better than ordinary cast iron, and what might be expected from it. There were, unfortunately, some people who thought that semi-steel would replace a steel casting, but there were very few cases where it could be successfully substituted. One of the principal reasons for the improvement in the mixture was the effect upon the physical condition of the carbon, particularly the free carbon. In ordinary cast iron the graphitic-carbon was in long plates, more or less continuous, and these formed centres of weakness where a fracture would readily start. A mixture of steel had the effect of splitting up these large plates, and the graphite appeared either in very small curly pieces or in a nodular form. Properly-made semi-steel could be had with the graphitic carbon in almost the same form as was obtained in malleable castings. Some time ago The Foundry Trade Journal had a leader on this subject and suggested as a definition that semi-steel was cast iron in which the graphitic structure had been modified; that was to say, made finer or nodulised by the incorporation of steel in the charge during its manufacture. That definition, so far as it went, was fairly good; it formed a basis for discussion, but he did not think it covered quite the whole ground. Something more than the fining and nodulising of the graphite was involved, the manner in which the carbon was distributed had to be considered, and he thought that the combined portion of the carbon should be in the form of well-developed pearlite. The matrix should be practically all pearlite. The best semi-steel was that which had a wholly pearlitic matrix, with the graphitic carbon very small or nodular in form, and uniformly distributed through the mass.

Methods of Manufacture.

There were two ways in which semi-steel could be made. First of all, they might take a quantity of molten iron and add to it a certain amount of steel. If they added the steel in a solid condition to the ladle it was a hopeless proposition. It did not produce that fining of the structure which was necessary, and furthermore, the quantity of steel which could be so added was exceedingly limited. It was only possible to add 1 or 2 per cent., and, as a matter of fact, adding it to the ladle was useless. He was inclined to say that it did more harm than good. They would possibly get blowholes or hard spots, and none of the properties which one expected from semi-steel. If, however, liquid steel was available, then by mixing together molten steel and molten iron a mixture was obtained which perhaps more nearly deserved the name of semi-steel than anything else. By that means they got low carbon and low silicon, while at the same time there was no chance of increasing the sulphur. The tendency would be to reduce the sulphur rather than to increase it. The other method of manufacture was to melt together a mixture of cast iron and steel in a crucible, an air furnace or cupola. Melting in a crucible was only suitable for very small quantities, and when carefully carried out gave results about the same as were obtained by mixing together the liquid steel and liquid iron. Melting in an air furnace allowed a little more control over the composition than in a cupola. It made it possible to lower the total carbon and silicon, if necessary, and probably was the best of all the methods. When, however, they came to everyday practice the cupola was the only feasible melting-plant. It was the only practical method, and if properly controlled gave very excellent results, the chief advantage, perhaps, being that it allowed the use of cheaper or lower grade irons for the production of high-class castings at a fairly reasonable cost. By melting the mixture in a cupola, however, the likeness to steel certainly became further dimmed. The steel entirely lost its identity, the characteristics of cast iron dominating. That, in his opinion, was a very important point—that at the most the only claim that could be made for this so-called semi-steel was that it was a high class cast iron. There was no doubt that this higher-grade material was exceedingly useful for certain purposes, and was probably the very best cupola metal. He did not propose to deal with crucible or air furnace melting, but would confine his remarks to cupola-melted metal.

Cupola Melted Semi-Steel Cast Iron.

At various times the possibility of melting steel in the cupola had been questioned, and a great many people found it exceedingly difficult to obtain a mixture that was even the equal of ordinary iron. He knew people who had given up the attempt, who said it was a fraud, and had returned to melting ordinary common iron, and if they wanted anything special used a cold-blast pig-iron. A great many of the difficulties were due to a want of appreciation of the conditions necessary for melting.

Why "Hard" Spots?

In the early days many people gave it up because they found the metal had hard spots or blowholes, generally explained by saying that the steel had not melted, the temperature not being sufficiently high, with the result that the steel had come right through the cupola and became embedded in the iron, forming hard spots. That was hardly a reasonable explanation, because if mild steel was melted and simply embedded in the cast iron one would expect it to be soft and not hard. It might be explained, however, in the case of turnings or borings added to the ladle the use of rusty material is detrimental because of a coating of white iron, being formed round the pieces causing hard spots, it is not due to the pieces themselves, but to the surrounding metal forming a skin; the question of surface tension also had to be considered. In the early days a good many people thought that to make semi-steel nothing was necessary but to shovel in a certain amount of steel. They took off so much pig-iron and iron scrap and replaced it by steel scrap and troubled no more about it. Of course, they were disappointed, and usually those people had the smallest conception of the proper working of a cupola.

Cupola Temperatures Sufficient to Melt Steel.

Most of those with whom he came in contact used the furnace with two or three very small tuyeres, and in order to get in sufficient air for the combustion of the coke they used an excessively high blast-pressure, giving a cutting blast, a form of working unsatisfactory even for cast iron, but very much worse when steel went into the furnace. Very often, also, an unsuitable grade of iron was selected for mixing with the steel. For a very long time the idea prevailed that it required a very much higher temperature for melting steel than the cupola was capable of developing. That, he thought, was a totally mistaken idea. He believed that in the cupola furnace it was possible to get a temperature sufficiently high to melt steel. He knew what a very high temperature it was possible to obtain with properly adjusted proportions of air and coke so as to ensure rapid combustion, and there was no reason why the temperature should not be sufficient to melt even dead-mild steel. He was quite prepared to admit that with some of the cupolas he had seen it would take them all their time to melt the lowest melting-point iron in existence; but with a cupola properly controlled, and proper blast adjustment, the temperature would be sufficient to melt any steel which one liked to put into it. The essential to success in making semi-steel was good cupola practice. If they had good cupola practice all the troubles usually ascribed to other causes would disappear. The best safeguard against those troubles and for the production of clean working, satisfactory machineable material was to have hot and quick cupola melting, and if the cupola was working hot and quick it was an indication that it was properly adjusted. The necessary conditions could not be obtained in a haphazard manner; attention must be paid to detail. Everything must be properly proportioned. Everything must be weighed or measured—pig-iron, ordinary scrap, steel scrap, coke, flux, and especially the air, must be either weighed or measured, and measured with a certain amount of care. The proportions must be thought out and adjusted to suit the particular conditions.

The quantity of air should be measured by a suitable gauge, either by volume or by weight; weight was really preferable although more difficult to carry out. If one had an ordinary volume gauge a little experience would soon show what variations were necessary with varying conditions of the atmosphere. Not only must they have the proper quantity of air, but the pressure of the blast was a very important item indeed. With semi-steel it was useless trying a high pressure blast. If they did, they were pretty well doomed to failure at the outset. Personally, he was in favour of keeping the lowest possible pressure of blast in any cupola. Even in a sixty-inch cupola, making semi-steel, he would not recommend any blast higher than 12 or 14 ozs. They could do it with 10-oz. pressure, and if they were obtaining the penetration and velocity of gases with 10 ozs. they produced a very much better metal. There was more dull metal caused through too-high blast-pressure than was ever made by having too little. The cupola should be designed when using semi-steel with a very generous tuyere ratio—one to four, or one to five. Another important item in securing successful working was the weight of charge in proportion to the size of the cupola. They must not put on charges which were too heavy. What they wanted was a moderate charge that would give them an even layer of the materials over the cupola area, just enough to cover it and allow the furnace to work easily. The material in charges should be distributed as evenly as possible, so as to ensure the free and easy working of the furnace, and also to maintain the proper level of the melting zone. That was a very important point. It varied with every cupola, but after a few trials one found out what was the best position of the melting zone for a particular furnace. As a general rule, the coke bed should be 22 or 24 ins. above the tuyere area. Once they had found what was the best position for the melting zone the furnace would work very easily and economically.

Raw Materials to be Used.

The question was often discussed as to what sort of steel to use in the manufacture of semi-steel. The best was undoubtedly mild steel, and was perhaps best of all when in the form of plate cuttings, not too thick. From ¼ to 1½ ins. in thickness was most favourable, and in moderate-sized pieces. Cuttings or crop ends of rails, joists, or similar material were very suitable, and punchings could be used so long as they were large. High carbon steel was not desirable. That was a point upon which a good many people had been puzzled—why it should not be as suitable as mild steel. As a matter of fact, one did not want the steel carburised before it was in the melting zone. If that happened they never had the same uniform mixture. High carbon steel acted very much like white iron when mixed with grey iron. There was a difference of density, and, furthermore, the question of surface tension came in. He advised them to avoid borings and turnings unless they had plant by which they could compress them into fairly solid briquettes in the same way as was done for Siemens' steel work. The turnings presented an enormous surface to the blast, and very little would eventually get into the iron in the form of steel. It would mostly be oxidised and passed to the slag, or if it was in the iron it was in an undesirable form, and would probably spoil the rest of the material in the charge. The coating of oxide formed a protective layer and prevented proper mixing. The same remark applied to rusty material. Another objection to rusty or fine material was that it more readily absorbed sulphur. At the best, in melting semi-steel there was a greater tendency for a sulphur increase in the cupola than with straight iron casting. The pig-irons most suitable for semi-steel working were irons which contained a moderately high total carbon. The total carbon should not be below about 3.5 per cent., and those containing 2.5 or 2.75 per cent. of silicon were often very suitable. They were better if they contained a fairly high percentage of manganese. Scotch types of iron were particularly suitable for semi-steel making, especially No. 1, or even soft No. 3. One thing was certain, the use of expensive cold-blast and special brands of iron of that type was not warranted. They were not successful; they offered no advantages, and in most cases the mixing of steel with high class cold-blast irons spoiled them. With cold-blast iron they got a reduction rather than an increase of strength, although in most cases wearing properties were rather improved and also resistance to temperature changes.

Is High Phosphorus Detrimental?

Another point which had been much debated was as to whether it was necessary to have hematite or very low phosphorus iron. The Americans seemed to insist that hematite iron was a necessity; that if they had any quantity of phosphorus the material would fail. With that he could not agree. Experience had shown that except in the

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case of material to meet very special conditions it was quite unnecessary to have a low phosphorus iron. As a matter of fact, a good deal of very successful work had been performed in semi-steel, using very high phosphoric iron, even Cleveland iron containing 1.3 or 1.4 phosphorus had given entirely satisfactory results. Certainly with a high phosphorus iron the transverse test and the impact value were rather less than would be obtained from an iron containing less phosphorus, but the tensile test seemed to be practically unaffected. As a matter of fact, castings for which high phosphorus iron was usually employed did not generally require to have very great strength. Steel was sometimes used for no other object than to close the grain and give a better surface when polished. Personally, he found that the best results were obtained, whether in semi-steel or straight cast iron, by having a moderate percentage of phosphorus—round about a half per cent. His experience was that even with cold-blast iron or straight cast iron 0.5 per cent. of phosphorus gave the best results. It gave the necessary amount of life to the metal, and at the same time soundness and freedom from blow-holes, which was often very difficult to get with lower phosphorus.

Manganese Should Be High.

Manganese was a very important element with regard to semi-steel. It appeared desirable to have manganese in the mixture charged in considerable quantities, because there was rather a heavy loss of manganese in melting, and the best semi-steel for general work should contain from 0.75 to 1.0 per cent. of manganese. Thereby they obtained very much cleaner and sounder castings, with better machining qualities, and also castings which took a better surface polish. The same results were not obtained by additions of manganese in the ladle.

Charging Conditions.

There had been a great deal of discussion on the subject of charging. For a long time everybody said they must charge the steel on the coke, because it would not melt unless it lay on the coke for a long time, and became highly carburised. In his opinion, that was wrong. His advice was for the first charge to put the steel scrap on the top of the coke bed, more as a precaution than anything else, then put on pig and scrap and the next layer of coke, and then for all the charges above that—pig-iron and ordinary scrap first, and steel on top. If they did that they would always find the steel was in advance. The quantity of steel that might be used would vary from 10 to 50 per cent. Below 10 per cent. it certainly was not worth while calling it semi-steel, as the quantity was too small to make any appreciable difference. A number of experiments carried out from time to time in small cupolas as well as ordinary cupolas showed that the steel melted before the pig-iron. The first reason for that might be in many cases that the steel was usually in smaller lumps than the pig-iron, and offered a bigger surface to the heating. He thought, however, it was mainly due to the high temperature which was developed, and also they had to bear in mind that pig-iron did not melt so very quickly. If they put a piece of grey pig-iron in a crucible and watched it, it was astonishing how long it took before it really melted. They had several times after the day's run put steel through the furnace and had it just to the melting point and then rescued it, expecting to find it very highly charged with, say, 1.5 or 2 per cent. of carbon. As a matter of fact, they had never found more than a half per cent. carbon in the material. But they did find that if the material had really melted away and run through the bed it took up carbon owing to the fact that real carbon absorption never took place until the metal was in a molten condition. That had been confirmed more or less by experiments made in America on the production of synthetic pig-iron in the electric furnace, where it was shown that no very extensive carburisation took place till the metal had actually melted. The experiments which he had carried out pointed to the fact that it could melt without this high degree of carburisation. In another set of experiments they had bars of iron and bars of mild steel of equal size bound together with the steel on top, and they found that the steel melted before the pig-iron, or at just the same time. Still, there was no very great carburisation in the steel, which rather refuted the argument that carburisation took place as a result of contact with the pig-iron before it was melted. Personally, he did not see how it could.

Fluxing Semi-Steel.

With regard to the use of fluxes, it was often stated that when melting semi-steel no flux was necessary. With that he disagreed. He recommended everyone to flux and flux well, because if they had a good, clean-running slag they had clean metal. The flux had a cleansing action on the metal itself.

Discussing the composition of semi-steel, Professor Campion said the principal point to be considered was the adjustment of the total carbon and the proportion of that total carbon which should be in a combined condition for any particular job. For ordinary castings total carbon should range from about 3 to 3.5 per cent. For castings, such as Diesel engines, it was best to keep the total carbon lower. Three per cent. should be the maximum, and if they could reduce to 2.8 or 2.9 so much the better. If they had the total carbon too low there was a greater tendency to chill or hardness than in the corresponding grade of grey iron. The best results for an all-round strength and reliability were obtained when the combined carbon ranged from about 0.6 to 0.7 per cent. in the form of a well-developed pearlitic matrix in the iron. That not only gave strength but good machining and wearing properties. Probably the most useful way of regulating the composition was that of taking the total carbon plus the silicon to equal certain definite figures for varying sizes. For castings 2½ to 3 ins. thickness the sum of the total carbon and silicon should vary from 4.1 to 4.2. In the case of castings from 1 to 2½ ins. thickness the sum ought to be, roughly speaking, 4.2, or, say, 4.1 to 4.3. With thin castings from 1 in. down to ½ in. or ¾ in. the sum ought to be a bit higher, about 4.7. With anything under ½ in. the sum certainly ought to be equal to 5. As a matter of fact, there was very little under ½ in. that was adapted for casting in semi-steel, or that really was desirable except in very small pieces. If there was a long run, such as gutters and rain-water pipes, semi-steel was not suitable.

Moulding Precautions.

There were certain precautions which had to be taken when dealing with semi-steel as regarded moulding. In green-sand moulding one had to work a little drier than with ordinary grey iron; as little swabbing as possible should be attempted. Some people swabbed with paraffin or kerosene and claimed that they obtained very satisfactory results.

Casting Conditions.

Greater speed of running was necessary, otherwise hardness resulted. Semi-steel required handling rather more quickly than grey iron. The gates and runners should be somewhat larger, and also the risers and headers. If the pouring was too slow the castings tended to be hard and difficult to machine, and perhaps deficient in toughness. In the case of castings of a very large area it might be necessary to increase the velocity by increasing the number of gates as well as the size of them, and in large flat work the silicon content could often be increased with advantage, also to prevent hardness.

Mr. E. Norman Ansell, Holborn Viaduct House, 12, Holborn Viaduct, E.C.1, has been appointed London representative of W. G. Birkinshaw & Company, Limited, tool makers, of Reliance Works, Derry Street, Wolverhampton.

The Tees Conservancy Commission announced at a recent meeting that the Rio Tinto Company desired to complete the purchase of land on the south bank of the Tees for the establishment of new copper works and a by-product plant.

Scottish Branch of the Institute of British Foundrymen.

Annual Meeting.

The Annual Meeting of the Scottish Branch of the Institute of British Foundrymen was held at the Royal Technical College, Glasgow, Mr. A. Lawrie, presided, and there was a large attendance.

Mr. John Bell, honorary secretary, submitted the annual report, which showed that the total membership on the register was 232, including 5 honorary and life members, 62 members, 148 associate members, and 21 associates. During the session that closed that day, he said, there had been seven branch meetings held. Council meetings had also been held regularly since the beginning of the session. He regretted that applications for admission to the Institute had not been made at a rate which would make up for the wastage due to deaths, resignations, and transfers. Among notable members removed by death were Mr. William Cumming, of Messrs. William Cumming and Company, Limited, Maryhill, and Mr. Donald M. King, Keppoch Iron Works, and among transfers were Mr. W. H. Bound, former secretary of the Branch, who had gone to Middlesbrough, and Mr. David McQueen, member of the Council, who had gone to Birmingham.

Perhaps the most outstanding feature of the session was the holding for the first time in Scotland of the examinations held under the Trust of the John Surtees Memorial. The Branch was not directly interested in this as a Branch, but as individual members they were. He would also like to record in the report the winning of the Institute Diploma by Mr. David McQueen, which they would remember was presented to him on January 12 by the President of the Institute, Mr. Oliver Stubbs. In the next place, Mr. Bell said, the members would be interested to know that the Council was very much alive to the necessity of the Branch taking its rightful place amongst kindred Societies and Institutions in Glasgow, and in this connection he wished to refer to a decision that had been recently made. They were all aware of the importance to the engineering industry of the Diesel engine, and like all other problems, this also had more than one side. One aspect of the problem was represented by the engineer and the other by the founder, and to get an interchange of opinion between the two sides—a matter which was very desirable—a small sub-committee had been appointed by the Council of the Branch to confer with a similar sub-committee of the local Branch of the Institution of Mechanical Engineers. The Foundrymen's sub-committee consisted of Mr. Lawrie, Mr. Affleck, and Professor Campion, and as Professor Mellanby was one of the representatives of the other side, they might rest assured that some tangible results would follow.

On the social side, Mr. Bell referred to the very successful dinner held on January 12, when the Branch had the honour of welcoming the President, Mr. Stubbs, and several other influential members of the Institute. It was hoped during the coming summer to arrange for visits to one or more of the important works in the West of Scotland, and also for an excursion at which the members would have an opportunity of meeting each other in a social capacity. In conclusion, Mr. Bell added, that the present was neither a time for congratulations nor for resting. It was a time for hard work on the part of those who had the best interests of the Institute at heart. Still, there was no need for pessimism. The future was theirs to make of it what they would. (Applause.)

The Report was approved unanimously.

Election of Officers.

Office-bearers for the ensuing session were then elected as follow:—Mr. J. Affleck, president; Mr. A. Mearns and Mr. Tom Bell, vice-presidents; Mr. J. A. Gardiner, Mr. R. Robertson and Mr. H. Winterton, members of Council for a term of three years; Mr. John Bell, secretary; and Mr. Winterton, representative of the General Council.

The John Surtees Memorial.

The Chairman then referred to the result of the examinations held in connection with the John Surtees Memorial and called on the examiner, Professor Campion, to give his report.

PROFESSOR CAMPION said it was a matter of great pleasure to carry through the examinations. In the Senior Division the competitors were asked to write an essay of about 1,000 words in length on one of the following subjects:—(1) Contraction and warping in castings. (2) Pattern-making from the moulders' point of view. (3) Test bars, their preparation and value as an index of quality to founder and user.

Three candidates submitted essays, and they all selected the first subject. The essays were all of a high order of merit, but that by Mr. James Gray dealt more thoroughly with fundamentals than the others, and he recommended that he be awarded the Gold Medal, and that a prize of books or apparatus of approximately 15s. in value be awarded to Mr. Robert D. Lawrie.

In the Junior Division an examination in general foundry knowledge, which was held in the Royal Technical College, Glasgow, on March 8, constituted the competition in this section. Eighteen candidates presented themselves. The following is a copy of the examination paper set:—

(1) It is required to cast a connecting piece, having the form of a conic frustrum 6 ft. long. The large end has an outside dia. of 3 ft. and inside dia. of 2 ft. 6 in. The small end is 2 ft. 4 in. outside and 1 ft. 10 in. inside. What is the weight of the casting?

1 cub. in. of cast iron = 0.26 lb.

(2) What are the chief differences between dry-sand, green-sand and loam moulding? State the kind of material and its preparation for each method.

(3) Describe as fully as you can the arrangement and construction of a foundry cupola, and the manner of working. Give sketches where possible.

(4) Explain briefly the following:—Venting, feeding, facing-sand, blackwash, drawback, riser.

(5) Describe as fully as you can the moulding in dry-sand of a small article from a solid pattern on a two-part box.

Answer four questions.

The work in the Junior Division was, on the whole, exceedingly well done, and gave evidence of keen interest in their trade on the part of the candidates, and also that they had taken full advantage of their opportunities of becoming acquainted with the technical side of foundry practice. The exercise in mensuration, however, was not well done. It was attempted by four candidates only, and not one of them arrived at anything like the correct solution. Three candidates gave the weight of the casting as being between 5 and 7½ lb. A moment's consideration would have shown them the absurdity of the answer, as the casting was 3 in. thick and 6 ft. long. Three candidates showed exceptional merit, and obtained more than 90 per cent. of the possible marks, and it was a matter of some difficulty to differentiate between them. Thirteen candidates obtained over 60 per cent. of the possible marks. Professor Campion recommended that in addition to the silver medal there be awarded two prizes of books or instruments to the value of 15s. each in this section, as follows:—

Silver Medal:—Robert McNab, Paisley.

Prizes:—Equal, Thomas Graham, Dumbarton; Vincent M. McGowan, Paisley.

In conclusion, Professor Campion said he wished to place on record the thanks of the examiner and competitors to the Governors of the Royal Technical College for the arrangements made for their convenience and comfort.

Presentation of Medals and Prizes.

The medals and prizes were presented to the successful competitors by Professor Mellanby, who said that all who knew Mr. Mayer knew he was a man of warm feelings and whose abiding idea was the advancement and improvement of the iron foundry business. He was convinced that John Surtees had been the means of bringing about an improvement in the engineering trade, and that engineers owed him a great debt for what he had done, a debt that was not properly appreciated. Mr. Mayer had spoken to him (Dr. Mellanby) on this subject several times, and said he would like to do something that would keep the memory of Mr. Surtees before those engaged in the industry, and inspire the younger generation. In instituting the medals and prizes, therefore, Mr. Mayer had done a very appropriate thing, and it would always be associated with the younger men.

Mr. Affleck, the newly appointed Branch President, then took the chair, and thanked the members for the honour they had done him in electing him to that position. In these days, he said, when British foundrymen had raised the status of their Institute, and when it had all the advantages and prestige of a corporate body, it was a great responsibility and a great honour for a man to be appointed to the presidency of the Scottish Branch. He would do his best to maintain that prestige, and with the enthusiasm that had been in evidence throughout the session, he had no doubt they were in for a real time of prosperity. They were privileged to have with them that afternoon Professor Mellanby, who was going to address the meeting. They would remember that on the occasion of the annual dinner, Dr. Mellanby had emphasised the importance of co-operation between the foundrymen and the engineers' institutions and he was there that day to give practical co-operation by addressing them.

Castings for Diesel Engines.

Dr. Mellanby said the remarks he wished to make related to cast iron for Diesel engines, and he did not intend to do more than give a preliminary talk on the subject. He referred more particularly to pistons, liners and possibly valves. In the first place, they had to consider whether they could hope to get cast iron that would stand up to the stress that would be brought to bear on it in Diesel engine cylinders. They might take it that the pressure in a Diesel engine cylinder was about 500 lb. per sq. in. Although 500 was an easy figure to remember they must recognise that the pressure was sometimes higher. The cylinder must be of a fairly large size, and it must be sufficiently strong to withstand the pressure, and it must be sufficiently light. A good quality of cast iron was therefore required of a high tensile strength. There was also another consideration. Cylinders and liners were subject to high-temperatures and there were severe temperature stresses set up, so great in some cases as to cause cracking. The same thing took place in the piston, where there was also great danger of stresses being set up by the temperature itself. If the centre of the piston was kept at a high temperature and the outsides cooler, the metal would be put into a state of stress which might leave serious results. In actual practice, however, things were not quite so bad because the whole of the heat was not radiated from the centre to the outside, but one should consider in air-cooled pistons there was always great danger of temperature stresses being set up.

In addition to strength and other properties, they must also consider whether cast iron work, when subjected to high temperatures, would keep its shape and its size, and therefore they wanted cast iron, which refused to be disturbed at such temperatures. They all knew that at high temperatures cast iron showed a tendency to "grow" very readily. His next point therefore, was, that cast iron required for Diesel engines, should be of a kind that would retain its size, and retain its dimensions somewhere in the region of 1,000 deg. F. As they knew, it was quite possible to get iron which had a high tensile strength and good "growth"-resisting properties, but which at the same time, would not have very good wearing properties. In practice, it had been found that good wearing properties were somewhat difficult to obtain. In the Royal Technical College, Glasgow, Professor Mellanby said he had carried out a few simple experiments to try to determine the wearing properties of cast iron. He then described the method adopted, and illustrated the apparatus by means of lantern slides. It had been found, he added, that good or bad samples, as determined by these experiments had generally turned out good or bad in practice. He also illustrated by means of diagrams and drawings thrown on the screen a number of tests which had been carried out to show the behaviour of cast iron at different temperatures, and its tendency to grow after repeated heatings. The main points for ironfounders to consider, he said in conclusion, was whether they could get (1) Cast iron which would withstand high temperatures and high pressure; (2) cast iron which would have good tensile strength, not only at normal, but also at high temperature; and (3) cast iron which would have "growth"-resisting properties. That was the ideal in cast iron which was put forward, and it was for them to do their best to attain to that ideal.

Professor Campion, who took part in the discussion which followed, said that he was fully in agreement with all that Professor Mellanby had said. He did not think that they would find in chemical analysis a solution of the problems with which they were faced. It narrowed down to a certain range the position that might be obtained, but much depended on the physical condition of the metal, the method of casting, the temperature of casting and so on, and even to a certain extent on the method of melting.

Mr. Hodgart said he thought this was a matter beyond the practical man to a large extent, as he had little opportunity of doing the necessary research work. He would therefore have to depend largely on what the theorist and the practical chemist told him. The Diesel engine was still something of a mystery to the practical man. At the same time they could not do better than follow the lead that had been given them, and try to carry out their own research. If they studied the papers that were read and published, they would get a good deal of available information. He thought the Institute was doing a good work in the dissemination of information on this matter.

Mr. Lawrie, in the course of a few remarks, suggested that if a refined iron was necessary for the purpose of Diesel engine castings, they would have to get back to the reverberatory furnace. He also added that if the engineer was to give any encouragement in order to get the best results, he would have to be a little more generous, instead of trying to get the work done at the lowest possible price. In other words, he would have to pay ironfounders if he was to get the best results.

Dr. Mellanby briefly replied to the discussion and deprecated the practice of some firms sending abroad for their castings for Diesel engines, such as cylinders, liners, etc.

Two short Papers were afterwards read, as follows:—

SOME FOUNDRY FAULTS, AS SEEN BY A PATTERN-MAKER.

By James Charters.

No person connected with the engineering trade can over-estimate the importance of setting out to find a solution for the many and varied problems of foundrymen. It is universally recognised that cause and effect are inseparable. There is no cause without its effect, and there is no effect without its cause. Every practical operation, even many that are considered quite outside of routine foundry work, can be brought to the assistance of the moulder. The larger the gifts of observation and common sense, the better will be the results in all things practical. These gifts are very valuable assets to any tradesman who has them and puts them into practice.

Methods of moulding adopted by one moulder produce results very much different from those adopted by another. He knew of a firm who had an offer for hundreds of tank plates in cast iron. Two patterns were made for the contract. One moulder put his pattern down on the level bed, and held his pattern in position by placing on it two

weights. Then he put his box down and started ramming up his mould from his position, which was outside of the moulding box. Another moulder got his pattern and placed it on the level bed. Then he placed his box in position. Then he mounted on to the centre of the pattern, and as the sand was shovelled in he kept ramming up from where he stood, his weight sinking or bending the pattern at the centre. The result was, his castings were always heavier than the castings made by the other man. The patterns were exchanged, and with moulding methods as before, the results were the same, showing that the man's weight in the centre caused the difference in weight.

As regards the variation in the weights of castings, sometimes caused by heavy rapping of patterns, or perhaps soft ramming, there seems to be a need for fixing a reasonable amount per cwt. of allowance. He had heard it said that 6 lb. per cwt. is sufficient, in most cases, to suit the jobbing foundry trade. A standard weight to be considered after, say, six castings have been made, and the average of the six castings to become that standard weight. The 6 lb. extra weight is not

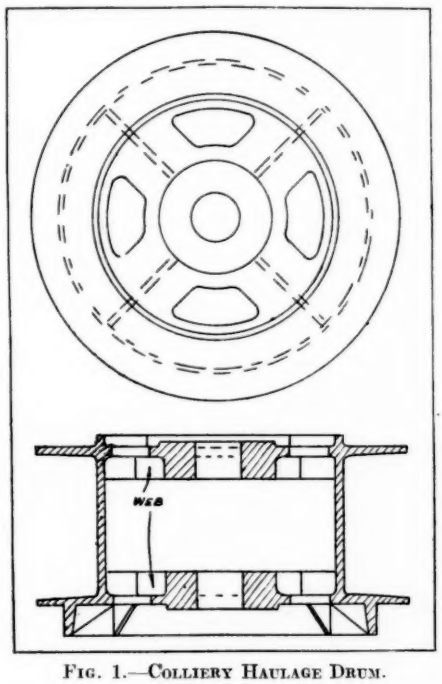

Fig. 1.—Colliery Haulage Drum.

allowed in pipe foundries where miles of pipes are needed to complete a contract. When it is remembered that a piece of metal 36 in. × 12 in. × 1 in. thick weighs 1 cwt., it is not difficult for even an apprentice to calculate the weight of a large diameter pipe or liner, or any circular casting which is tubular and of equal thickness of metal, such as piston rings. There are some points which the foundrymen overlook.

Take, for example, a casting of a colliery drum as shown in Fig. 1.

The mould was made in three parts, and the partings were made as shown. When the moulder was finishing off his mid part, he did not use the pin board provided, which would have given the correct surface for the top flange to rest upon, but he made his parting level with the top of the middle part of the pattern, and did not use any sand to take the impression of the top flange when he placed it in position. The angle was specially needed on the casting to avoid friction with the wire rope in winding.

Some Suggestions.

While it is intended to point out a few of the moulders' faults and worries, the Author admits there are faults on all sides. If draughtsmen had some practical experience of engineering, and if all patternmakers had some practical experience of the foundry, time in the engineering shop would be saved, and the moulders would be more successful with their castings. These important branches of engineering production must, sooner or later, definitely co-operate. The draughtsman must so design that he will help the engineer, while the patternmaker must take a fuller interest in his work with a view to helping the moulder and the engineer. If a system of this kind were established, and if capable representatives of the various branches indicated examined the drawings, and kept in view economy in production, it is certain that in many cases there would be considerable economies following on thoughtful and sympathetic co-operation. Some modern engineering establishments give rewards for improvements of tools. Messrs. Denny of Dumbarton do this, and it is difficult to see why all foundries should not do the same.

If a moulding box is improved by the worker, or if the spindle apparatus generally used in foundries is not what it should be, why not see to it and have such tools improved? The spindle apparatus can be greatly improved. The ship's propeller, for example, is very often not a true screw when it should be. Loss of speed to an ocean liner is not infrequently put down to slip, *i.e.*, the movement of the sea not allowing the propeller to get a thrust from the disturbed water, though part of this so-called slip is caused by displacement of the water by the ship itself. One thing is certain, that is, if marine engine draughtsmen with observing eyes visited some foundries in which propellers are made, they would be ashamed to repeat some of the errors they observe in the foundry. Though not in general use, there is an improved spindle apparatus which gives to the propeller blades a true screw on the entire length of the blade. The same apparatus can give an increasing or decreasing pitch at any point of the blade where it is required to be, and almost an assurance that one blade will be practically the same weight as another. When this is done, less propeller trouble will be called slip and more " to the opinion " that the propeller was not made as designed.

Marine Engine Parts.

If one has ever been present when large triple-expansion marine engines were being adjusted, one would have noticed that on the main shaft there are weights fixed to counterbalance the weights of engine parts. These weights can be reduced by more careful moulding of the propeller, and by the better moulding arrangement mentioned in connection with the spindle. The balance weights referred to cannot be eliminated, but still their weight can be reduced.

Cores of varying shape can also be swept up by a suitable spindle apparatus, even though these cores are not circular. All that is needed is a template of the core required, and one template is sufficient if the core required does not exceed much in height what the core will be at the base. If the desired core stands high, then an extra template can be fixed on a flange, which can be fixed to the spindle at the position required to give the length of core. In other respects, the spindle fittings must have an arm with suitable joint or joints to do the work which remains.

There is one more point which is worthy of consideration by officials in the foundry trade, and that is the urgent need of teaching foundry and engineering shop apprentices how to read drawings. The sooner the apprentice is taught how to read a drawing properly, the sooner his interest in his work will be increased. An experienced loam-moulder once stated that he liked his trade because it assisted to make engines for steam ships and castings for other large pieces of machinery which, later, he had seen in motion. There is no reason why an apprentice moulder should be kept ignorant of the place the casting he makes has in the construction of an engine of a machine. Boys talk to each other about their work, and if they were told a little about why the castings were needed and their use, foundrymen would be training in the foundry a more intelligent apprentice. These are days of specialising. It has been said that some moulders who have been for a long time making oven doors to suit the right hand side of a range, have difficulty in making a similar casting for the left side. Be that as it may, mass production methods have come to stay. In desiring progress

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foundrymen must keep in mind the need for skilled workmen, and with this in view, they must pay more attention to the training of apprentices, as it is only on them that we can count later for help in maintaining Britain's place among the nations.

PROBLEMS IN OIL SAND CORES.

Mr. John McEachen, Kirkintilloch, afterwards gave a short address on "Problems in Oil Sand Cores." He said he wished to deal with a few oil-binders under standard conditions, and to place before them the results of a series of tests. He first drew attention to the difficulties which foundrymen had to face in using oil binders. They would find, he said, that the casks of oil were not all the same, and on the following day they might find the cores soft, and put the blame on the core-maker, or on the drying. There seemed to be no standard among oil binders, as would be seen from a slide which he threw upon the screen. Some did not understand their own oil, and some would have the foundrymen treat them their own way whether right or wrong. He had tried to make up one that he could rely on, and he had succeeded with one which was based on linseed oil, using river sand or pit sand, both found locally, and both equally successful in getting a good bond. He had with him samples of No. 4 and No. 5, so that they could try the bond, wet and dry. In fact, this sand could be wrought just the same as the regular old core sand. Most oil cores could not be handled, but just carefully put into the stove. There were a few that stuck to the core box very easily. The one which he exhibited could be handled, and it came clean from the corebox, just like the old core sand.

That system proved a saving of time, it required less ramming, fewer core-irons, fewer vents, and less fettling, while oil sand did not scab. It therefore produced a more perfect casting. It might be asked could those who used oil cores in extra heavy work get it to stand in the case of castings of from 4 in. to 6 in. thick of metal. He had not tried castings so thick yet, but he thought that one which he exhibited would stand up. It could, of course, be treated hard or soft to suit the job. Mr. McEachan exhibited a number of specimens to illustrate his remarks.

Electric Furnaces.*

By A. Glynne Lobley, M.Sc.

After a general survey of the subject, dealing with the classification and characteristics of the different types, the lecturer passed on to the application of the electric furnace in the non-ferrous industries. Various furnaces designed for the melting of non-ferrous metals were reviewed and compared, among them being the Rennerfelt, Detroit, Booth, Baily, Ajax-Wyatt and Ajax-Northrup Furnaces.

The lecturer said that criticism was often made on the grounds of unreliability in the absence of unskilled attention, high capital and running costs: however, most modern furnaces were quite reliable if not fool-proof, but he agreed that the capital cost was often unnecessarily high, even allowing for the small demand which at present existed; the running costs, on the other hand, were by no means heavy where electrical energy could be obtained at a reasonable price. Increased furnace loads by improving the load and power factors of the supply would tend to reduce the cost of electricity.

A comparison was made of the thermal efficiency of the various kinds of furnaces, both fuel and electrical.

Emphasis was given to a plea for an extended use of the simple and reliable wire-wound furnaces. Examples were given of what has been done on a large scale in America. The lecturer gave an account of his personal experience with the design and use of metallic resister furnaces ranging from small laboratory types to industrial annealing furnaces: these had not only been found to be more satisfactory in every way than the fuel furnaces they supplanted, but had also been cheaper to erect and to operate.

Some account was given of the principles governing the design of metallic resistor furnaces; this was illustrated with curves connecting furnace size and temperature with the power required, and current with the size of resistor. Details were shown of a method of winding and connecting the heating elements.

The lecturer concluded with an account of a new non-metallic resistor for temperatures up to 1,350 deg. C. (2,460 deg. F.).

* Extract of a Paper read before the Birmingham Metallurgical Society.

Canadian Iron and Steel in February.

According to the Canadian Bureau of Statistics, the production of pig-iron in Canada during the 29 days of February amounted to 60,288 long tons, a decline of 3,414 tons from the 63,702 tons produced in January. Although the output of basic iron rose 32 per cent., to 19,126 tons, there was no malleable iron produced, and this drop more than offset the advance in the other two grades. While the total production showed little change as compared with the preceding month, it marked a decided advance over the February outputs in each of the last three years.

The production of ferro-silicon was 2,689 tons, a drop of 7.6 per cent. from the 2,910 tons produced in January. This output consisted entirely of the grade containing a low silicon content.

During the month two additional furnaces were blown in at Sydney resulting in seven furnaces being in blast at the end of the month. The active furnaces were, two at Hamilton, Ont., two at Sault Ste. Marie, Ont., and three at Sydney, N.S.

In the United States 3,074,757 tons was produced in February, making an average daily output for the month of about 106,000 tons, or a daily gain of 8,600 tons over the January output, when the 3,018,890 or 97,000 tons daily was produced.

Steel Ingots and Castings.

The total February production of steel ingots and castings in Canada amounted to 70,953 tons, an advance of 72 per cent. over the 41,309 tons produced in January. The increase was almost wholly accounted for by the rise in the quantity of open-hearth basic steel ingots made for the use of the producers. The output of this grade amounted to 68,002 tons, or 76 per cent. over the 38,606 tons of January. In addition, 102 tons of alloy steel ingots was produced. The total production of steel castings amounting to 2,849 tons, showed little change from the 2,705 tons produced in February, but while acid open-hearth and bessemer castings dropped slightly, this loss was more than offset by the rise in the quantity of basic open-hearth and electric castings produced.

While the production in February was slightly below the average monthly output of 74,000 tons for 1923, it marked a decided advance over the tonnages produced during the corresponding month of the last three years. The cumulative steel production for the two months of 1924 amounted to 112,262 tons, including 106,710 tons of steel ingots and 5,552 tons steel castings.

The machine tool market of Canada held well to the January level. The orders for railway equipment recently placed are being reflected in the demands of the car builders for machine tools. The motor vehicle industry has been making enquiries for new works, and Northern Ontario mines are said to have placed a number of good orders.

The American Exchange Paper.

Owing to circumstances beyond his control, Mr. J. Fletcher Harper, of the Allies Chambers Manufacturing Company of Milwaukee, finds himself unable to present his Paper to the Newcastle Convention. The American Foundrymen's Association have secured one on "Casting in Permanent Moulds," by Mr. R. J. Anderson, of the United States Bureau of Mines. Mr. Anderson has a world-wide reputation, and British foundrymen can consider themselves fortunate in having a contribution from his pen.

Institute of British Foundrymen.

COVENTRY BRANCH.

Discussion on Mr. Shaw's Paper on Physical Tests for Cast Iron.

THE CHAIRMAN (Mr. A. Harley), in inviting discussion, said the Paper was an exceedingly interesting one on a subject which vitally concerned every foundryman and engineer.

Square Test Bar Preferred.

MR. ROXBURGH, of Rugby, speaking with reference to the recommendation of that Committee that round test bars be used for transverse tests, said he was of opinion that the square or rectangular bar would give a better indication of the stress that castings would stand than the round bar. If the castings made in this or any other country are considered, he would say that the structure of a square or rectangular test bar would be more in line with the structure of the metal in 99 per cent. of these castings than that of a round bar. A round bar gives higher transverse test than a square bar of the same sectional area, and he would therefore like Mr. Shaw to say why the round bar was recommended for this test

He drew Mr. Shaw's attention to a rather peculiar test result he recently encountered. As the lecturer was aware, the foundry with which the speaker was connected is called upon to meet fairly high physical tests. The foundry was running a mixture with the Si content approximating 1.3 per cent. to cast two jobs with test bars attached. The moulding box for one of these jobs was rather tight, and the moulder was therefore obliged to put the test bars very close to the castings, and, owing to the slow rate of cooling, the management naturally expected somewhat low tests.

The tensile bar was cast at 1⅝ in. dia., and the transverse bar at 1¼ in. sq. In the case of the other casting identical test bars were cast-on, but they were in a position well removed from the casting. When the bars were broken it was found that the tensile bar which was cast close to the casting only gave 9.87 tons per sq. in., whereas the transverse bar, which was also cast close to the casting, gave 3,300 lbs. per sq. in. The test bars of the second casting both gave fairly good results, namely, tensile bar 13.7 tons per sq. in., transverse bar 3,420 lbs. per sq. in. It seemed rather peculiar that the transverse bar should give such a good result, in view of the big drop on the tensile bar, and both cast under similar conditions. Had Mr. Shaw encountered anything like this in his experience, and could he give some idea as to the cause? All the test bars were sound.

Reasons for Round Bars Explained.

MR. SHAW replied that in regard to a round bar the matter turned entirely on the point as to whether the bar represented the casting or the metal. If it represented the metal, then they wanted to arrive at something which would give them the least variables. It would be well to remember that in all patterns, if at all possible, sharp corners and angles were eliminated. That a square test bar showed diagonal lines of crystallisation, and a tendency for small cracks along the sharp edges. With a round bar both these drawbacks were minimised. The matter was, of course, open to discussion, but both the I.B.F. and the American Committees, after going thoroughly into the matter, supported the round bar. In any case it was necessary to have a square transverse bar so as to give a similar crystalline effect as the flanges of the casting it represented. For the same reason the tensile should be cast square and turned round. The question of the strength of the bars mentioned by Mr. Roxburgh depended on the composition of the metal, and the cooling effect on the mass. As shown in Graph II it was quite possible to have any of the three-sized bars in the I.B.F. the strongest, according to the composition. As stated there, if the C.C. was round about 0.9 per cent., that of the three-sized bars was the strongest. It was also shown that from the same metal poured into bars at the same time, it was possible to have 3 per cent. C.C. in the ⅞ in. dia. bar while there was only 0.9 per cent. in the 3 in. dia. bar due to cooling effects only.

MR. ROXBURGH: The 0.9 carbon was in the same ladle and cast in another casting.

MR. SHAW added that much would depend on the size of the bar, for he could get 3 per cent. in one bar and 0.9 per cent. in another.

An Engineer's Views.

A Visitor said that engineers had not really a satisfactory figure on which to design. Supposé they had three transverse test bars, and one was to correspond to a certain casting with a breaking point of not less than 3,000 lb., another of 3,300 lb., and the third 4,200 lb. Now the engineer did not build his machines on round test bars of the same size, and consequently those figures meant nothing to him unless he knew the stress to which he could subject the various classes of machines. He would then have to turn to the tensile test, which was not much use for cast iron, especially if in testing these results afforded them no absolute units. Of course, there might be a bigger variation in big test bars. Taking, however, the test result of 25 lbs. per sq. in. in conjunction with the modulus of rupture, they did get at the amount of stress a casting should sustain, and they could use it as an absolute figure in calculation. If transverse tests were given from the metallurgical laboratories instead of tensile tests they would certainly know more about the compression and tensile qualities of the material, and they would also have something more definite to work upon than in the tensile test, as in machining and gauge length operations the chilled portion was torn off. For this reason engineers preferred one size of bar, for if they knew it was broken at 2.000 lb., it suggested something definite to them, whereas if another size bar were used which was figured to break at 3,000 lb. they would naturally decline it because of the absence of reliable comparisons. He was in agreement with Mr. Roxburgh in his remarks as to the use of the square test bar, because castings were normally rectangular, and not round. Moreover, in a round bar the stress was concentrated at a certain point, but in the case of the square test bar it was uniform and all over the surface, which the speaker illustrated by a rough diagram. Urging the dependability or advisability of the modus of rupture, the speaker mentioned that he had, for a period of twelve months, made a series of tests with an inch square bar, one of 12 in., and another of 22 in. length. These two figures were in the ratio of 54.5 per cent., according to the recognised formula. Now the average figure on the 12 in. test was something like 53.9, so far as he could recollect.

Bases for Designers.

MR. SHAW thought the last speaker had missed the whole point. The specification gave definite figures for the various thicknesses of castings, and so the engineers had something to start from for their designs. They reckoned on—(AN INTERRUPTER: 1½ tons per sq. in., but what did that mean?) That meant tension. (THE INTERRUPTER: But if the foundryman gave the engineer a figure to design on it would be better.) Before that could be done much would depend on the design. What the speaker insisted upon was that sufficient care was not expended on the design from the foundry standpoint. As far as possible uniform thickness should be incorporated. Then, if the casting was about an average of 1 in. thick, present day tests asked for 21 cwt. on an in. sq. bar at 12 in. centres. If the casting averaged 2 in. thick, and a 2 in. sq. bar was used, tested at 12 in. centres, they would expect to get approximately 168 cwts. (THE INTERRUPTER: I do not quite agree, because they are not in direct ratio. If you have a bar 1 in. sq. and another 2 in. sq., the one would not have a breaking load of four times.) Theoretically it ought to have eight times, but due to size would have a more open centre, and the breaking load might fall a little. (THE INTERRUPTER: Oh, no; there is the moment of inertia.) After further passages, Mr.

Shaw laid down that the bar should bear some relation to the thickness of the casting; that was the whole point of the controversy at present. With regard to the square or round bar for the transverse test, it was not a question of the load. (THE INTERRUPTER: Quite.) The round bar might give a wrong deflection, due to sinking in of the top and bottom steel bearings. (THE INTERRUPTER: It would affect stress, because stress is distributed all over the piece.) To this Mr. Shaw answered that he had not considered that point, but even if it was so, as they proposed to use all-round bars, the stress would be comparable. With regard to the deflection, this gain due to sinking in of the steel bearings or the large bars could be met by special bearings, or there was a machine that automatically deducted the amount of sinking in.

Automobile Castings.

MR. G. H. JUDD said he might point out, because he did not know whether Mr. Shaw was aware of it, that in Coventry, where the majority of the foundries were engaged in motor cylinder work, the average thickness of cylinders was ½ in. to ⅝ in. He believed that at last the automobile section of the B.E.S.A. had tackled the question for the district, and had now allowed them to use a ½ in. sq. transverse bar which called for 400 lb. It was quite a small bar, but for cast iron it was certainly more representative of the casting and comparable with it than the 1 in. sq. bar originally called for. They also tackled the question from the flywheel point of view for motor cylinders, although the majority were made in steel pressings, but where it did apply to cast iron a 1 in. sq. bar was allowed, equal to 2,000 lb transverse and 11 tons tensile. So that in their district they were trying to approach the question and make test bars comparable with the castings. (MR. SHAW: Thank you.)

MR. H. BEENY, referring to the remarks of a previous speaker, said that he had been making test bars, cast in sizes ranging from 3-16 in. to 1¼ in., in order to demonstrate the influence of the rate of cooling upon different grades of cast iron. When the first set was broken—the bars were cast in duplicate—and he had calculated the results to the square inch, on the assumption that the cross-sectional area and the breaking stresses were proportional, he found that instead of getting a maximum transverse result at a certain critical rate of cooling, the figures rose steadily upwards, so that on the 1¼-in. bar, with a very grey iron, he obtained the highest transverse value. Now that was not what was expected, as he anticipated that the maximum transverse test for each grade of pig-iron would occur on some intermediate section. The second batch of bars were turned to exactly ½ in. dia., and when broken on the transverse machine the maximum was obtained. When he examined the other figures obtained with the first bars he found that, if he assumed that the transverse test was proportional to the cube of the diameter of the bar, then the figures obtained from the bars broken at various sizes agreed quite well with those obtained from bars broken after being turned down to 0.5 in. dia. Could Mr. Shaw quote them the formula used in calculating the figures given in the tentative specifcation?

MR. SHAW replied that he could not at that moment, but he could send it on. The figures were published, and were obtained for them by the Professor of Engineering at Birmingham University.

MR. BEENY added that assuming the transverse was proportional to the cube of the diameter of the bar, the figures came out very well, there being approximately 1 cwt. per sq. in. difference between the two sets of values.

MR. SHAW observed that of course a great deal would depend on the quality of the iron as to whether they obtained the maximum strength on the small or the big bar.

MR. SHAW commented on the importance of the combined carbon constituent, saying that it might be 0.8 or 0.9, or even 0.71, which Professor Turner had reduced it to, and was for that particular iron the highest test; while Cook found it one point higher. What they wanted to know was the suitability of iron for the size of bar. If the iron was too hard for a small bar they would expect a drop.

Test Bars Useless for Automobile Cylinder.

MR. F. H. HURREN remarked that while he was in practical agreement with what Mr. Shaw had said about the value of test bars, he should like to qualify that agreement by stating that test bars were exceedingly useful on cast iron which was used on structural or constructional work generally. But as Mr. Shaw had expressed a wish to "have the gloves on," he would like to oblige him by saying so far as automobile work was concerned, he really could not see the practical utility of a test bar in connection with motor car cylinders. These cylinders were required to perform certain functions, and the chief factors required of them were effective long life, freedom from abrasions, general resistance to porosity, and standing up to the work of what was very often a high revolution engine. The question as to whether the material in automobile cylinders would give 11 tons tensile or 21 cwt. transverse tests did not to his mind matter twopence. The main thing was that the material must stand up to its work day in and day out, often under bad conditions, with bad driving and lack of lubrication. And the matter of tensile or transverse tests had no relation whatever to the necessity which was all important in a cylinder—its long life under varying conditions. Mr. Shaw had also mentioned that, so far as chemical composition was concerned—and it had also been stated in Coventry—a phosphorous content of between 0.4 and 0.8 was harmful. He thought this point required some elaboration. From practical experience he had found that an iron which which was suitable for automobile cylinders, taking into consideration the total carbon and silicon content, if it had a phosphorous content of that range, was always liable to segregation. The chief and most desirable factor in automobile cylinders was a very short cooling range, and this could only be obtained by what little they knew of the balance of chemical constituents. A cast iron with less than 0.2 or over 0.8 per cent. phosphorus, assuming there was a silicon content of approximately 1.5 per cent., would give far better results day in and day out than a similar iron with a phosphorous content of 0.2 up to 0.8 per cent. The only explanation he could offer for this experience was the dimension of the cooling range. Mr. Oliver Smalley, when lecturing there recently, showed some bars with a cooling range in one case of only 80 deg., while in the other instance it was somewhere about 250 deg. To his mind an iron for an automobile cylinder which had the latter cooling range was liable to all sorts of trouble, local segregation and local porosity, however good or bad the iron might be. In such a case they might still be getting a good test bar, but he would rather obtain a good casting with a bad test bar than a bad casting with a good test bar. However, he could not suggest any alternative test, but he would like to add his opinion that test bars for automobile cylinder work were a waste of time.

MR. SHAW, in reply, agreed with Mr. Hurren entirely on this particular point, because cylinders were small castings, and they also had the Brinell test instead. Moreover, they could easily test the casting by water pressure, before machining, and under these conditions he did not think a test bar was necessary for automobile cylinders. He might explain that he simply mentioned the phosphorus question because he had heard it whispered twice, and had only referred to it as a tool to prove that their chemical knowledge was not complete.

Stress Estimation not Practised.

MR. R. N. AVELINE thought the last gentleman put the case for the engineer in a nutshell. So far as engineers in that district were concerned, what they required was a uniform standard of quality in the castings supplied, and this under very different conditions from those of the ordinary tensile test. He suggested that very few engineers ever worked out stress figures for cast iron parts. In the case of automobile cylinders, previous designs were generally followed, and the selection of the metal to be employed was not usually a result of stress estimation. But he could see Mr. Shaw's point when he said the quality of the metal going into the casting was the factor for the foundryman to keep a check on; because it was surely unfair

to expect the foundryman to produce cylinders giving engineers the desired results unless he was perfectly sure each day that he was putting into the mould metal of a certain composition. The first cylinder of the batch might be perfectly satisfactory, but Mr. Shaw had shown them that although the chemical composition of the iron might be more or less the same, the physical results of the metal might be very different, if the mix were slightly altered. He would like to ask if Mr. Shaw's Committee had experienced any difficulty in trying to compromise between engineers' views in cases of responsibility for the design of such parts as were of a widely differing nature. Of course, the strength of a structure such as a bridge was actually calculated, whereas that of many automobile parts was not. With regard to the size of test bars, there was just one difficulty, and he was not quite clear how Mr. Shaw proposed to overcome it. This was that if they were having a multiplicity of sizes of test bars, was it not going to complicate their testing equipment? Granted a transverse test on most machines could be fairly wide, and most of the machines could accommodate a varying span and varying thickness of the bar: in a tensile test it must be a question of some difficulty. For example, if many test pieces of the section which Mr. Shaw had shown—a round section about 3 in. in diameter—had to be tested along with the ordinary standard small one, certain additional labour in the testing department would be involved in changing chucks and jaws continuously. Concluding, Mr. Aveline enquired had anything further been done regarding the impact test for cast iron. One had read of further experiments being carried out, and that would certainly be a direction in which more research was necessary. So many automobile castings were subject to shock, and probably on that basis the engineer would find the most beneficial results from any standardised form of test.

Mr. Shaw, commenting on these remarks, said the speaker was relying on somebody else's work. The first cylinder must have been designed. Were they to place more value on the testing machine than on the strength of the casting, they must make a testing machine do the job. As regards big bars, it was only a question of taking the grips out, and they had to do that to make a test at all. But he was sure that so far as Coventry was concerned this question was not a serious one. Suppose they had a big casting, was it to be marked out and machined before they had any idea of its capabilities? Or if they had a £1,000 casting must they wait till they put the test on the casting before they could tell whether the metal was even suitable? They, as foundrymen, did not mind what test was employed so long as it was one which foundrymen could make under proper conditions and the engineer would accept. That was what they were out for. As to the impact test, he used nothing else, but whether it was a good one or not he was still open to doubt. He used a French one, with a direct drop of ½-in. at a time, but was not at all sure that on some metals he obtained relative results. On some semi-steels they had consecutively good results, but on hard metals he was not so satisfied. They had not found any definite data yet.

Mr. Beeny's Contribution.

Since the meeting the following data has been supplied by Mr. Beeny to Mr. Shaw:—

The test-bars mentioned which were round were cast vertically in green sand in sizes varying from 0.5 in. up to 1¼ in. dia., two bars being cast off each size. One set was broken in transverse between 12 in. centres with the skin on, and gave the following results for a grade of iron containing T.C. 3.56 per cent., and Si 1.39 per cent.

(D_3) diam. in ins. of bar at fracture.	(W_2) Transverse cwts. on selection.	(W_1) Transverse calculated to 1 sq. in.
0.510	2.261	24.65
0.630	4.500	25.81
0.755	8.125	27.09
0.897	12.50	24.84
1.021	18.38	24.77
1.148	26.50	25.13
1.284	34.00	23.03

Certain of the remaining set of bars were machined down to 0.5 dia., and broken in transverse under the same conditions as before.

(d_1) Dia. in ins. of bar before machining.	(d_2) Dia. in ins. of bar after machining.	(W_2) Transverse cwts. on section.	(W_1) Transverse calculated to 1 sq. in.
0.505	(not machd.)	2.250	25.05
0.633	0.50	2.391	27.43
0.760	0.50	2.578	29.57
0.895	0.50	2.375	27.24
1.020	0.50	2.250	25.87
1.285	0.50	2.125	24.31

It will be seen that a very fair comparison is obtained between the bars broken in the various sizes as cast, and the corresponding bars broken after machining to 0.5 in. dia.

The question raised concerned the method of calculating the values obtained on bars of various sizes to one standard area of cross-section. The writer has used the following formula:—

$$W_1 = \frac{d_1^3}{d_2^3} . W_2$$

Where W_1 = Transverse value in cwts on round bar having an area of 1 sq. in. and dia. d_1 in. (= 1.128 in.).

W_2 = Transverse value in cwts. obtained on bar having dia. of d_2 in.

The contributor would be obliged if the author could tell him whether this conforms with that used in drawing up the specification for the testing of cast iron.

These bars were actually cast in various grades of foundry iron in order to study the effect of different rates of cooling upon the microstructure and physical properties.

THE AUTHOR'S REPLY.

Mr. Shaw has sent the following answer:—

The formula used is quite correct for a comparison of different diameter bars tested at the same centres. The test figures forwarded are very interesting, but lose some of their value because the variation in diameter of the bars is not sufficient to have a great effect on structure. If the bars had ranged from 0.5 to 3 in. dia. his results would have been quite different. It is also evident from the results that the metal was suitable for the medium size bar, and so one would not expect much cooling effect with the 5-16 in. increase of the diameters either way. The experiments are worth repeating, using bars varying from 0.5 in. to 3 in. dia., with metals suitable for each size. Then he would find a vast difference in the results when compared with the formula.

Contracts Open.

Cairo, April 30.—Weighing machines, etc., for the Physical Department of the Egyptian Ministry of Public Works. The Department of Overseas Trade.

Eccles, April 21.—(1) Rotary distributors, penstocks, sluice valves, special cast-iron pipes, etc.; (2) storm-water pumps, electric motors, etc., for the Sewage Disposal Committee. Mr. T. S. Picton, borough engineer and surveyor, Town Hall, Eccles. (Fee, £2 2s., returnable.)

Hull, April 23.—Railway bridge, for the Hull Corporation. Total weight of steelwork, 232 tons. Mr. F. W. Bricknell, city engineer, Guildhall, Hull. (Fee, £1, returnable.)

Smethwick, April 24.—Supply and erection of a four-lift spiral-guided gasholder, three-and-a-half million cub. ft. capacity, for the Gas Committee. Mr. E. Hardiker, engineer and manager, Gasworks, Rabone Lane, Smethwick. (Fee, £2, returnable.)

Switzerland.—An inquiry has been received from Switzerland for the names of manufacturers, in the United Kingdom, of machines suitable for the production of steel shavings as used for household cleaning purposes. The Department of Overseas Trade.

Switzerland.—Attention is drawn to possible openings for the sale of pig-iron, cast iron, steel castings, rails, points, signalling and interlocking appliances to the Federal Railways. The Department of Overseas Trade.

XUM

Trade Talk.

ORDERS FOR 3,500 tons of rails and fish plates have been placed abroad by the Midland Great Western Railway of Ireland.

B. BARNETT (ELECTRICAL ENGINEERS), LIMITED, have removed from 117, Whitechapel Road, E.1, to 331A, Romford Road, London, E.7.

J. M. WOTHERSPOON & COMPANY, LIMITED, have removed from 6, East India Avenue, E.C.3, to 194-200, Bishopsgate, London, E.C.2.

FLEMING, BIRKBY & GOODALL, LIMITED, announce that the correct name of the firm is now Fleming, Birkby & Goodall, Limited (Branch of Card Clothing & Belting, Limited), West Grove Mill, Halifax.

A NEW COMPANY has lately been formed in Sydney, N.S.W. (343, Sussex Street), with a capital of £10,000 and the title, Poldi Steel Company (Australia), Limited. A branch is also being established in Melbourne.

A FIRE which, fortunately, did not cause much damage, broke out at Dorman, Long & Company's Newport Ironworks, Middlesbrough, last week. The damage was confined to a couple of trucks and some naphthalene.

THE IMPORTS OF FOREIGN IRON ORE at the Senhouse Dock at Maryport for the quarter ended March 31 amounted to 22,450 tons, against 19,900 tons for the previous quarter, and 33,350 tons at the corresponding period of last year.

VICKERS, LIMITED, Barrow-in-Furness, have secured the order for a second unit for the Holborough Cement Works, Halling, Kent, comprising a large rotary kiln and cooler, and all subsidiary machinery, including electrical equipment manufactured by the Metropolitan Vickers Electrical Company, Limited. They are at present erecting the first unit of the plant, and this work is now nearing completion. The most up-to-date practice for the manufacture of cement is embodied in the works, and each unit will have a capacity of 50,000 tons a year.

THE EMPLOYÉS of J. Perks & Sons (1920), Limited, Monmore Green, Wolverhampton, have a wonderful record of long service. Thirty of the oldest employés have a record of 1,031 years' service. The firm have 50 other employés with more than 20 years' service each, and in some cases three generations of several families are employed at the works. It is also interesting to note that the firm have been in their present premises for 113 years, during which time it is stated they have never had a dispute of any seriousness or a strike of any kind.

CHRISTMAS & WALTERS, LIMITED, have received an order from the Earl of Dudley's Round Oak Works, Limited, to install a plant of R. D. Wood gas machines, each gassifying up to 2 tons of coal per hour, complete with gashouse, gas tubing and coal-handling plant. Other R. D. Wood gas machine plants are now being installed for Baldwins, Limited, and for the Patent Shaft & Axletree Company, Limited. The concrete side of the company's business is also very busy, they having received many orders recently for Blaw patent metal shutterings for concrete formations.

IN ADDITION to the contracts mentioned previously, Ed. Bennis & Company, Limited, are supplying a coal and ash-handling plant to Adam Hamilton & Sons, Limited; one coal bunker to M. Oldroyd & Sons, Limited; 73 sprinkler stokers and furnaces to various firms; re-linking one Bow chain grate for Achille Serre, Limited; two hand-fired furnaces and six stoking furnaces for other firms; four chain-grate stokers, one independent boiler elevator, one rotary truck tippler, etc.; and lastly a coal and ash handling plant to serve a range of eight water-tube boilers for the G.W.R. Central Power Station at Swindon.

SPEAKING AT A luncheon in connection with the annual meeting at Birmingham of the British Non-Ferrous Metals Research Association, on April 4, Mr. Thomas Bolton said the president of the Institute of Metals, in a speech in London, had sounded a warning note as to supplies of non-ferrous metals, and he thought it was suggested that the time would soon come when exhaustion of those supplies might possibly be in sight. That seemed to be all the more reason why they should make the best and most economical use of those metals while they had them. If they could succeed in retaining the interest of scientists it was not inconceivable that by the time those resources were exhausted they might have gained such intimate knowledge and possibly control of the internal structure of their materials that transmutation of metals might be no longer the dream of the alchemist but a definite possibillity by the application of modern science.

Personal.

MR. T. ROWE has resigned his seat on the board of the British Electric Transformer Company, Limited, and has been succeeded by Mr. S. S. Lambert.

MR. A. G. COOKSON, steelworks and general assistant to the chief engineer, has been appointed assistant stores superintendent at Swindon for the Great Western Railway.

MR. HERBERT BATES, of Hulse & Company, Limited, Salford, has been elected president of the Manchester Association of Engineers for the year, in succession to Mr. Cecil Bentham.

MR. JAMES THOMPSON, of the firm of John Thompson, Limited, boiler manufacturers, Ettingshall, Wolverhampton, has been returned to the Wolverhampton Town Council without opposition.

MR. A. E. TATTERSALL has resigned the position of treasurer of the Institution of Railway Signal Engineers. His successor is Mr. A. B. Wallis, of the Telegraph Department at Derby of the L.M.S. Railway.

Wills.

FISHER, W. J., chairman of the Barnsley Smokeless Fuel Company, Limited ... £5,904

WALLACE, W., Monkstown, County Dublin, of the firm of Wallace Brothers, coal merchants £8,212

COOKSON, E., of Wollaston, Stourbridge, director of M. & W. Grazebrook, Limited, ironmasters, Netherton, C. Akrill & Company, Limited, ironfounders, West Bromwich, and the Stourbridge Refractories, Limited £22,532

Parliamentary Notes.

Brass Scrap.

Replying to SIR JAMES REMNANT, MR. SNOWDEN said that the Disposal Board took all necessary steps with a view to disposing of the 120,000 tons of brass scrap to the best advantage before the contract with the British Metal Corporation was entered into.

In the Board of Trade returns the following changes are shown in the directorate: Mr. A. D. Clift resigned and Mr. F. R. Phillips was added in December, 1919, as alternate director to Sir L. Phillips. Mr. R. W. Rucker was added in August, 1920, Sir R. S. Holland was appointed alternate director to Sir L. Phillips in March, 1923, and Mr. F. R. Phillips resigned. Captain Oliver Lyttleton, D.S.O., M.C., was appointed alternate director to Sir C. Budd in September, 1923, Mr. F. A. Govett was appointed additional director in January, 1924. None of these gentlemen had been or were connected within three months of the signing of this contract with the Ministry of Munitions or the Disposal Board in any capacity whatever.

He had no information as to what consignments went to ports en route for Germany, nor had he any information whether any of the directors abovementioned were connected with subsidiaries of the Metallgesellschaft of Frankfort.

Excess Profits Duty.

MR. GRAHAM informed MR. HANNON that he was unable to state the amount involved by claims for repayment of Excess Profits Duty at present under investigation, as many of them were disposed of locally without being brought before the Commissioners of Inland Revenue. Repayments found to be due were made immediately the amount was finally ascertained. The gross amount of Excess Profits Duty (including Munitions Levy) paid during 1923-24 was approximately £23,500,000; the gross amount repaid during the same period was £25,400,000.

SOME OF THE MORE IMPORTANT recent orders received by the Underfeed Stoker Company, Limited, include 41 travelling grate stokers for the Norwich, Carlisle and Maidstone Corporations, Isle of Thanet Electric, Brunner, Mond & Company, Dunston Power Station, Hongkong Electric Station, various stations in Japan, etc.; 10 Underfeed stokers for Belvedere Hospital and the Beck Estate; air heaters for the Dunston Power Station; pulverised fuel plants for the North Metropolitan Electric Power Company and St. Pancras Borough Council; ash conveyors for Brunner, Mond & Company and the Carlisle and Walsall Corporations; and suspended arches for the Hammersmith Borough Council, Hull Corporation, Dunston Power Station, and Bryant & May.

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—The Cleveland pig-iron market is steady, but values have not held to the recent higher levels. There has been considerable buying in the home trade of late, but business now appears to have fallen off somewhat, owing, no doubt, to the tear of industrial troubles and to the approach of the holidays. Moreover, consumers are pretty well covered for the time being, and can afford to wait. At the moment, nevertheless, the position is pretty healthy, and the feeling is one of reasonable optimism, tempered always by the unknown quantity of industrial trouble. At last Friday's market No. 3 G.M.B. was somewhat lower at 92s. 6d. per ton. No. 1 is still very scarce, and strong at 100s. No. 4 foundry is round about 91s. 6d., and No. 4 forge in the neighbourhood of 90s. 6d. per ton.

The stiffening-up process in hematite, which has been noted during the past week or two, continues steadily, if very slowly. At last week's market, in consequence, there was a rather firmer attitude all round. Sellers would not quote East Coast mixed numbers at less than 99s. per ton, although possibly against a substantial firm offer they would be willing to make a small concession. No. 1 is 99s. 6d. to 100s. per ton. On the West Coast prices are unaltered, Bessemer mixed numbers being quoted at 112s. 6d. to 115s. per ton, delivered at Glasgow and Sheffield, and 117s. 6d. to 120s., delivered at Birmingham.

MANCHESTER.—The position here in the foundry iron market is certainly stronger, and there seems now to be no possibility of lower prices in the near future. One cannot say that very much new buying has yet occurred, although many of the furnace agents assert that they have been doing rather more business lately. Makers of Derbyshire No. 3 iron are now very firm on a basis of 95s. at the furnaces, and some of them are inclined to ask 1s. to 1s. 6d. per ton more, although contracts can still be made on that basis.

THE MIDLANDS.—In the South Staffordshire area demand for pig-iron is very restricted, consumers' purchases being for immediate requirements, and when they buy their negotiations are marked by extreme pressure for reductions. This last fortnight, however, it has not been so easy to secure concessions. It is not possible to mark up quotations any higher, but they continue very firm. Quotations:—Northamptonshire No. 3 foundry, 92s. 6d.; Derbyshire No. 3 foundry, 95s.

SCOTLAND.—In spite of the recognised fact that pig-iron is being sold to-day at well under the cost of production, consumers are, generally speaking, content to look on. A few users, more shrewd than the others, and some of the merchants, are quietly making purchases, and will, no doubt, have cause to congratulate themselves ere long. Meantime, the price of No. 3 Scotch foundry is 100s. per ton, f.o.t. furnaces, and, with a better inquiry and more business being done, makers and merchants alike are inclined to be firmer in their ideas.

Finished Iron.

Last week's increase in marked bars was due solely to the advance in wages and fuel. The past quarter has been an extremely good one for the makers of this quality of bar iron, but some makers freely confess that their order lists for the coming quarter are rather thin and the prospects are not quite so good as they were three months ago. Apparently there is still some quantity of railway work to be given out before the recently-announced programme is completed, but the general trade is quieter than it was. The crown bar trade is very disappointing. Of course, the increase in production costs has had a stiffening tendency in individual cases where there is a moderate amount of work booked, but generally there is anything but good conditions, and there is quite a lot of inactive plant. Common bar makers are not meeting with such severe Continental competition, either in price or the quantity of imported material offering, but they are still unable to make any appreciable headway. Quotations:—Marked bars, £15 (net f.o.t. makers' works); crown bars, £12 10s. upwards; nut and bolt bars, £11 10s.; gas strip, £13, all net delivered Birmingham area.

Steel.

The outstanding feature of this section of the trade is the distinct signs of improvement in the demand for small bars and tube strip. Good specifications for this class of material have been placed in the Midlands quite recently, and £10 per ton for small rounds, flats and squares appears to be the current figure. Orders for bolt and rivet rounds have been received in appreciable tonnages, and the re-rollers are busier just now than they have been for some time. Even at £10 per ton the price is very low, and it is incongruous to find sectional materials, joists and small bars at the same figure, which is the case just at present. The ferro-alloy market is a very poor one, and has been in a very unhealthy condition during the last week. Every class of alloy seems to have sagged, and the only outstanding feature has been that of silico-manganese, and, peculiarly enough, 45 per cent. ferro-silicon.

Scrap.

The Manchester market for scrap iron is rather better this week than it was, although the improvement is not yet very pronounced. There is no inquiry for steel scrap, and dealers here are almost afraid to offer for it. Some of them now offer only 70s. per ton for heavy steel melting scrap, and this price looks absurd against the 100s. per ton which is paid for heavy wrought scrap. The market for cast scrap is quiet, but scarcely so depressed as it was. The firmer tone in the pig-iron market is helping it to a certain extent, and it is hoped by dealers that when the iron-founders of Lancashire begin to buy pig-iron for the present quarter they will also turn their attention to cast scrap, which is certainly cheap. Some dealers now quote 95s., delivered, for the best lots of textile machinery scrap, although it is still possible to buy this class of material at 92s. 6d. For good ordinary broken machinery metal about 90s. is usually quoted. In Scotland heavy machinery cast-iron scrap is in better inquiry this week, and is being quoted at 97s. 6d. to 100s., according to quality. Ordinary cast in handy pieces is about 92s. 6d. Light metal is easier around 77s. 6d., with firebars at 75s. Re-rolling steel rails are still in fairly good demand at 105s. to 110s. per ton. The above prices are all delivered f.o.t. consumers' works.

Metals.

Markets have been very depressed, and prices have in all directions more or less substantially declined. With confidence severely shaken and sentiment adversely affected, buyers have not so readily met the rather heavy liquidation and bear selling which has taken place. No doubt the previous optimism was a good deal overdone, and this, together with the unsettled labour outlook in this country, and the uncertainties arising out of the exchange situation on the Continent, have contributed to bring about the decline.

Copper.—The standard market, in the absence of speculation, has been inactive. It is generally admitted, however, that at present levels copper is a cheap metal, and it is not likely, therefore, that any further decline of note will take place. Intrinsically, the position is sound, but there appears to be a movement in America among the producers there to obtain higher prices. They are threatening to curtail production, and also are agitating for an import tariff on the cheap South American production. There is a possibility, therefore, of the price being forced up to an artificial level, especially if speculators again decide to interest themselves in this market. Current quotations:—*Cash*: Thursday, £64 7s. 6d.; Friday, £63 17s. 6d.; Monday, £64 5s.; Tuesday, £64 5s. *Three months*: Thursday, £65 5s.; Friday, £64 15s.; Monday, £65 2s. 6d.; Tuesday, £65 2s. 6d.

Tin.—Prices have again been decidedly weaker on renewed aggressive forward selling. It is considered in many quarters, however, that a recovery will soon be seen. The result of the March statistics was not so poor as had been anticipated, and this has induced more confidence. It is pointed out that when the "pooled" Eastern stocks that have been liquidated are taken into account there is a very considerable decrease in the visible supplies as compared with a year ago. It is officially reported that 3,364 tons of tin were exported from the Federated Malay States during the month of March, as compared with 3,246 tons in February and 2,704 tons in the corresponding month of 1923. The total export for 1924 is 10,544 tons, as against 8,912 tons in 1923 and 8,554 tons in 1922. Current quotations:—*Cash*: Thursday, £256 5s.; Friday, £241; Monday, £245 10s.; Tuesday, £243 10s.; *Three months*: Thursday, £255 10s.; Friday, £239 10s.; Monday, £244 10s.; Tuesday, £243 5s.

Spelter.—Values of this metal have also been lower. Demand on the part of consumers in this country, though tending to improve, has still been disappointing. This reflects the comparatively quiet conditions which have latterly surrounded the galvanising

industry, where some improvement is already overdue. The market on the Continent remains quiet, and producers there exhibit no anxiety to effect sales, present values being unattractive. Prices are now at the same level as they were at the opening of the year, when the recent upward movement started, and, indeed, must be getting near to a point which offers little remuneration to producers; further serious decline, therefore, seems unlikely. Current quotations :—*Ordinary* : Thursday, £32 2s. 6d. ; Friday, £32 ; Monday, £32 7s. 6d. ; Tuesday, £32 7s. 6d.

Lead.—The position of this metal is a little easier, metal being offered for sale with rather more freedom, and though consumption is still good, demand is less urgent. Fluctuations for the time being seem likely to be confined within comparatively narrow limits. Current quotations :—*Soft foreign (prompt)* : Thursday, £33 5s. ; Friday, £32 10s. ; Monday, £32 ; Tuesday, £31 10s.

Company News.

Alpine Metallurgical Company, Limited, 6, Serjeants Inn, London, E.C.—Capital £2,000. Secretary (pro tem.) : J. E. Bracher.

City Metal Company, Limited.—Capital £1,000. Directors: R. R. Margrie and W. H. Margrie, 60, Aberdeen Park, Highbury, London, N.

R. H. Ferguson, Limited.—Capital £30,000. Ironmasters and founders, etc. Directors: R. H. Ferguson, D. Gabrielson and E. G. Oliver, 101, Eaton Place, London, S.W.

Co-operative Tool Supply Company, Limited.—Capital £10,000. Provincial directors: M. Schalik, S. Lourie, S. Beloff and M. Nassatisir, 58, St. Gabriels Road, London, S.W.2.

Bucks Electric Wire & Engineering Company, Limited, 4, North Street, New Bradwell, Bucks.—Capital £500. Directors: A. H. Hyde, C. F. Townsend, A. H. Applin, A. E. Eats and Mrs. D. E. Hyde.

J. W. Hall (Ashton-under-Lyne), Limited, 150 Stamford Street, Ashton-under-Lyne.—Capital £2,000. Hardware and metal merchants, etc. Directors: J. Bottomley, H. Bottomley, H. Dean, G. Garside and R. Wood.

O. J. Wilmot, Limited, Wilmot Trolley Works, Wodcester Road, Malvern Ling, Worcs.—Capital £3,000. Wagon and truck manufacturers, engineers, etc. Permanent directors: O. J. Wilmot (managing), A. W. Steynor and H. S. Steynor.

Peirson & Company, Limited, Lincoln House, High Holborn, London, W.C.—Capital £5,000 in 4,800 £1 A and 4,000 1s. B. Structural engineers, etc. Permanent directors: E. Morgan, R. W. H. Gillett, C. Brown and A. W. Parrish.

T. S. Syndicate, Limited.—Capital £50,000 in £1 shares, to adopt an agreement between Mrs. F. A. de Silva (trading as the World Steel Company) and C. B. Bernard, and to carry on the business of ironmasters, steel makers and converters, colliery proprietors, etc. Solicitors: Ashurst Morris, Crisp & Company, 17, Throgmorton Avenue, London, E.C.

Wayne Tank & Pump Company, Limited, Ingersoll House, 9, Kingsway, London, W.C.—Capital £5,000 in £100 shares. General and mechanical engineers, manufacturers of oil pumps, tanks and storage systems, etc. Directors: W. M. Griffin (president Wayne Tank & Pump Company, U.S.A.), C. E. Franks (managing director), B. F. Geyer, E. A. Zern, W. H. P. Gibson, 49, North Side, Clapham Common, London, S.W.4.

Lecturing upon the question of "Gas Firing and Flame Control," before the members of the Society of Engineers in London, last week, Mr. A. C. Ionides, Junior, claimed that the principles of gas firing mostly employed hitherto were fundamentally wrong. With respect to relative merits of hard and gaseous fuel, it should be observed that even when they fired with peat, wood, coal or any other hard fuel they were really, though mostly unconsciously, heating with gas, the difference being that when they burnt hard fuel they were gasifying the fuel in a haphazard and wasteful manner, whereas in the other way they were doing so consciously and delivering the fuel in a form which could be applied with far greater effect. Times out of number had a heating device been fired with town gas far more economically than with hard fuel, in spite of the therm in the form of town gas costing six times what it cost in the shape of hard fuel. During 14 years amongst heating propositions he had encountered but one good argument to support the use of hard coal against the use of gas. This was in connection with steam-raising for power.

Obituary.

Mr. James Harrop, a director of William Heap & Company, Limited, machine-tool makers, Ashton-under-Lyne, died recently in his 79th year.

Mr. A. A. James died at his residence, Princes Road, Edgbaston, recently. Mr. James was the managing director of the A. A. James's Wire and Spinning Works, West Bromwich.

Mr. D. Livingstone, who died after a brief illness at his residence at Hessle, East Yorkshire, was the chairman of the firm of Livingstone & Cooper, shipbuilders and engineers, near Hull.

Mr. Thomas Leonard Bell, consulting engineer, who died at Hessle last week after a few days' illness, was chairman of the Hull Road Motor & Electrical Engineering Company, Limited. He was 57 years of age.

Mr. George Rushworth, iron and steel merchant, of Colne, died recently at the age of 80 years. The deceased gentleman was well known in the trade in the North of England, being chairman of Rushworth Brothers, Limited, the Crane Works, Colne, Lancashire, and of the Long Ing Shed Company, Limited, Barnoldswick.

Mr. Noble Haley, formerly chairman of E. & W. H. Haley, Limited, ironfounders, Bradford, and son of the late Mr. Elisha Haley, one of the founders of the firm, died last week at his residence, Farcliffe Terrace, Manningham, Bradford, in his 80th year. At one period he was hon. secretary of the Bradford Engineering Employers' Federation.

Mr. George Henry Capper has died at his residence, 33, Thornsett Road, Sheffield, after an illness extending over several months, at the age of 66. In early life he went to the Hallamshire Steel & File Company as foreign correspondent. Later he went to the firm of Hobson, Houghton & Company, and about 25 years since he became general manager of Wincobank Rolling Mills, and that post he occupied up to the time of his death.

Mr. John A. Service, of Paterson & Service, engineers and merchants, 38, Bath Street, Glasgow, died recently. He served his apprenticeship with Lamberton & Company, of Coatbridge, and was afterwards engineering draftsman with the National Tube Compony, Pittsburgh, U.S.A., and mill designer with the Baldwin Locomotive Company in their steelworks at Lewistown, Pa., prior to commencing business on his own account.

Gazette.

Mr. S. O. Cowper-Coles, Rossall House, Thames Street, Sunbury-on-Thames, galvanising plant manufacturer, has been adjudged bankrupt.

Mr. S. Burridge, 4, Chelsea Road, Sheffield, steel merchant, lately carrying on business at 21, Change Alley, Sheffield, has been adjudged bankrupt.

The Bordesley Engineering Company, Limited, are being wound up voluntarily, with Mr. A. A. Miller, 39, Waterloo Street, Birmingham, as liquidator.

Messrs. A. J. Clark and H. Fothergill, machinery agents, 2, St. James Square, Manchester, trading under the style of Clarke & Fothergill, have dissolved partnership.

The shareholders of the Derby Aluminium Castings Company, Limited, have decided to wind up the company voluntarily. Mr. J. Sedgwick, 36, St. Mary's Gate, Derby, has been appointed liquidator.

Messrs. E. T. Cook, J. Murphy, and G. W. L Case, engineers, Nelson Works, Wellington Street, Slough, Bucks, trading under the style of the Nelson Engineering Company, have dissolved partnership. The business will be carried on in future by E. T. Cook and G. W. L. Case.

Messrs. W. A. Pendrous and A. H. Pendrous, trading under the style of Pendrous Bros., Dixon Street, Monmore Green, Wolverhampton, founders and pattern makers, have dissolved partnership. Mr. W. A. Pendrous will continue the business under the style of W. A. Pendrous.

Mr. W. R. Gresty has been appointed receiver and manager of the Hansen Shipbuilding and Ship Repairing Company, Limited, of Cleavehouses, Northam, near Bideford. The Bideford yard has been closed, and about 120 hands have been discharged. The Appledore repair yard, where 80 men are employed, has work for a few weeks.

"The Protection of Eyesight in Industry" was the subject of an address delivered by Dr. J. Pendleton White, Falkirk, to the members of the Falkirk and District Ironfounders' Accident Insurance Company and Trade Unions. He emphasised the importance of proper lighting arrangements in workshops, pointing out the damage done to the eyes by improper lighting.